1953
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CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER
CHARLOTTENLUND SLOT — DANEMARK

ANNALES BIOLOGIQUES

VOLUME NO. X

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Scheme for the Arrangement of the Material.

I. Review of Investigations and Essential Results.

Each Committee Chairman should here give a summary of the contributions received, i. e., a statement of the nature of the material as well as a short review of the position in the area—including the main results obtained—during the last calendar year (unless otherwise stated). This review should only in exceptional cases exceed 2 pages (about 10,000 units of type). Papers should reach the General Secretary not later than 1. June.

II. Tables and Conclusions.

A. Environment.

1. Strength and direction of currents: especially data collected during spawning seasons.

2 a. Temperature and salinity conditions: Tables and/or diagrams including anomalies.

2 b. Seasonal temperature variations at selected stations: Data including anomalies.

3. Phosphate concentration, oxygen, etc.: Tables and diagrams to include anomalies.

4. Plankton conditions: Tables and/or diagrams, especially anomalies in distribution of indicator forms, phytoplankton patches, amount of plankton and fat content.

5. Abundance of benthonic food: Data.

6. The main meteorological features of the year: Data especially as to sunlight, rainfall and direction and force of the wind.

B. The Fish.

For each species in the following order: gadoids (cod, haddock, saithe, others), flatfishes (plaice, dab, flounder, sole, witch, lemon sole, halibut, others). herring, sprat, mackerel, other pelagic fishes, eel, redfish, others.

1. Abundance and distribution of eggs and larvae.
2. Abundance of year-classes: Data derived from experimental hauls.
3. Size- and age-composition of commercial catches or landings.
4. Average length of age-groups: Data from experimental hauls and commercial catches, with standard deviations.
5. Rate of growth: Data from marking experiments and quantitative experimental hauls.
6. Rate of mortality: Data from marking experiments and quantitative experimental hauls.
7. Intensity of fishing: Data as to the fisheries considered in 3, 4, and 8.
8. Quantities landed:—
   (a) Total catch (weight) of special fisheries,
   (b) Percentage of large, medium and small,
   (c) Total number of the various species,
   (d) Size- and age-composition of commercial catches or landings.

C. Shellfish.

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PREFACE

NOW that 10 volumes of the *Annales Biologiques* have been issued, it may be opportune to survey their history.

Owing to the war conditions, four years elapsed from the time when the decision was taken to issue this periodical (Berlin 1939) to the publication of the first volumes (1943). It comprised data for 1939—1941. Four years later (1947) the second volume appeared covering the period 1942—1945, in 1948 the third one, covering 1946, and in 1949 two volumes were issued (for 1947 and 1948). Since then it has been possible to issue one volume annually, referring to the previous year.

The first two volumes were edited by the late Dr. H. Blegvad, and Volumes 8 and 9 by Dr. Å. V. Tåning. Furthermore, Dr. Aa. J. C. Jensen acted as co-editor of the first eight volumes, assisted by Dr. Marie Rehder and Mrs. H. Harder of the Council's central office. In the preface to Vol. 8 Dr. Tåning expressed the Council's best thanks to all these people for their valuable offices, and it is now my turn to thank him for his good work, which is appreciated by the Council.

The ten volumes of the Ann. Biol. which have now been issued, comprise altogether more than 1700 pages, or nearly 1650 pages if general introductions, title pages etc. are not considered. If all this material were to be printed today, it would cost 170,000 Kr. — no honoraria being paid.

It is of interest to note to what extent the Ann. Biol. has been used as a place for publication of contributions from the various committees and various countries. The greatest contributors among the committees have been the North Sea Committees (462 pp.), and the North-Western Area Committee (338 pp.). At the other end we find committees which are hardly represented, as for instance the Whaling Committee (4 pp.) and the Salmon and Trout Committee (4 pp.)[1]). The shares of the various countries have also been very unequal, the greatest contributors being Denmark (418 pp. or 26.8%), Scotland (250 pp., 16%), and Norway (162 pp., 10.4%).

We arrive however at the most interesting and actual statistical survey, if we consider the four last years only (1950—1953, Vols. 7-10), during which the Herring and the Shellfish Sub-Committees have existed, and "normal" conditions have prevailed. Through volumes 7-9, the total number of pages increased from 158 (7) and 186 (8) to 226 (9), but is now 202 pp. (10). The rather rapid increase might indicate a danger, and care should be taken to keep as strictly as possible to the standard, as originally intended, and to avoid any unnecessary expansion, which might soon lead beyond the limits of the Council's financial capacity.

In these last four volumes the contributions amount to 707 pp. (prefaces etc. omitted) and are divided between committees as follows:—

Herring	22.0%	Atlantic	13.4%	Baltic	3.6%
North-Western	21.8	Transition	6.7	North-Eastern	2.9
North Sea	19.6	Shellfish	6.4		

The introductions etc. form 3.6%, and the total number of pages amounts to 772 (100%), or 193 pp. on an average for each of these four volumes.

Considering now the relative contributions by countries we get the following survey (7—10):—

Scotland	23.0%	Holland	7.7%	Sweden	2.0%
Denmark	21.8	Germany	6.0	Portugal	1.1
France	10.8	Belgium	4.4	Finland	0.3
Norway	7.9	England	4.2	Ireland	0.0
Iceland	7.8	Spain	3.0	Total	100.0

[1]) Data from this committee (as from the Hydrographical and Plankton Committees) form part of the sections from the Area Committees.

It is to be noted that nearly 77% of the material comes from 4 committees and that 3 countries out of 14 yield more than 55% of all contributions.

At the Council Meeting in Paris, October 1954, a radical revision of the committee-system, which will have a far-reaching effect on the Ann. Biol., was made. From Vol. **11** and onward four new committees will appear, namely: The Gadoid Fish Committee, The Comparative Fishing Committee, The Sardine Committee and The Scombriform Committee, all of which require room on the pages of the Ann. Biol. As a counterweight to this development there will be four Area Committees less than there have been since 1949, and there will probably be fewer contributions from each of the Area Committees because some important groups of fish are removed from them and dealt with in the new committees.

Those who are interested in the idea behind the Ann. Biol., its planning and development through the years, can be referred to Rapp. et Proc.-Verb. (Vol. **109**, I, pp. 24, 27, 31—32; Vol. **110**, pp. 108—12 and Vol. **116**, I, p. 27) and to the prefaces to Vols. **1**, **2**, **6** and **7** of Ann. Biol. The Ann. Biol. is primarily intended for publishing "a summary of correlated biological and hydrographical data for each annual period 1st December to 30th September, containing mainly a record of data, in the form of summary tables and/or diagrams, with short explanatory text as required and, when available, including comparative past data for the purpose of reviewing changes over a period of years". It has been attempted to keep the Ann. Biol. on this practical line but the period of time dealt with in recent volumes is with few exceptions the calendar year, which is a more practically defined unit than the earlier financial year of the Council.

The Ann. Biol. is the only periodical of the Council, which is intended to give short surveys of the most important fish stocks in the various areas from year to year. It is of the greatest importance that any contribution be kept in short terms, underlining the main features of the animal populations dealt with and of the environment, omitting details as far as possible. It is true that an editor is responsible for the Ann. Biol. as a whole, but it should be kept in mind that the fundamental preparation and responsibility rests with the Chairmen of the different committees. Without the closest co-operation from them in keeping the Ann. Biol. on its right lines and within its right limits, the efforts of the editor and the staff of the Central Office will be frustrated.

On the second page of the cover of the Ann. Biol. the general scope of the series is outlined for the guidance of the chairmen and committee members. It is desirable that chairmen should follow the general plan outlined there, as far as possible, and for the promotion of good and quick co-operation they and all their contributors are kindly asked constantly to bear in mind the following points:—

1. The Ann. Biol. is intended for, and should be strictly limited to, what is typical for the year in question, as compared with other years, may it concern hydrography, fish stocks, or other features, bearing on fluctuations.

2. Tables and figures should not overlap each other too much, and it should be kept in mind that tables are intended for reference and exact comparison, figures for survey.

3. The text should be very short, chiefly limited to the necessary explanations of tables and figures. The preparation of a volume of the Ann. Biol. is a team work "par excellence", where every title and piece of information must be brought to fit the whole in order to form a general survey of the situation. Consequently it is not possible to make major corrections or amendments of the text when a volume has reached an advanced stage of preparation, and the question of reprints to individual workers is practically impossible to deal with.

4. One of our problems are the illustrations which should be delivered ready for reproduction in clear and clean design. It is particularly necessary that any lettering should appear in adequate size to fit the figure in its final reduced size.

I wish, finally, to express my best thanks to all chairmen and contributors to this volume, and to Dr. Marie Rehder and Mrs. H. Harder of the Central Office, for their valuable collaboration, which I greatly appreciate.

Árni Friðriksson.

North-Eastern Area.

ENVIRONMENT

Plankton.

Zooplankton Investigations in Western Norway during 1952-53.

Zooplankton investigations were carried out in some fjords in western Norway during 1952—53 as in 1950—51. The stations are shown in Figure 1. Gear and methods used were the same as in previous years (GUNDERSEN 1951).

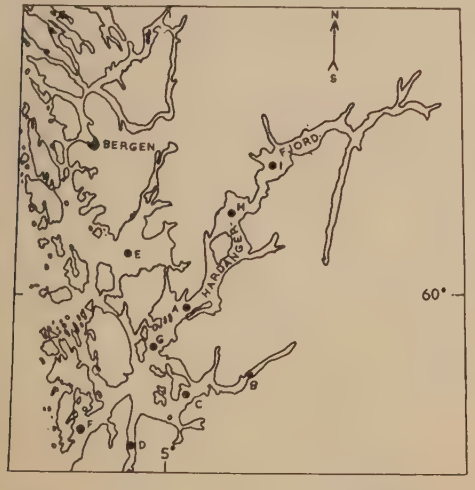


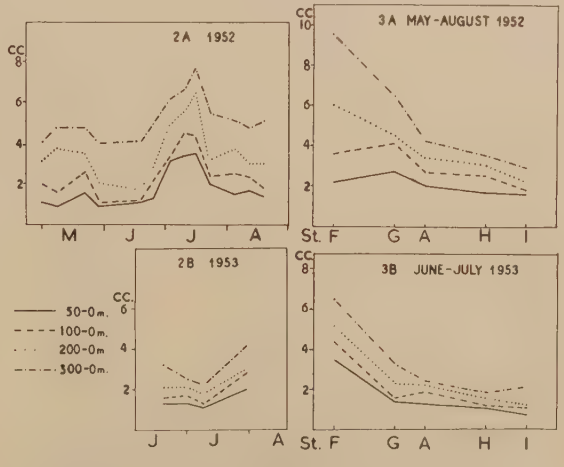
Figure 1. Chart showing areas. • Stations.

In 1952 the investigations started at the end of April and continued to the end of August. In 1953 the stations were only visited four times from the middle of June to the end of July.

The average volume of plankton at stations A-E varied in the same way in 1952 as in earlier years (Figure 2 A). We find peaks in May and July, but they are not so pronounced as in 1950—51.

In 1953 (Figure 2 B) we miss the usual vigorous increase and the volume remained small during July.

The stations F, G, A, H, and I are situated in a longitudinal section of the Hardangerfjord, the distances between them varying from 15 to 30 kilometres. In 1952 (Figure 3 A) the average volume of plankton in this section is a little higher than in the year before, and in



Figures 2 A and B. The variation of the average volume of plankton in the vertical hauls at stations A—E. 1952 and 1953.

Figures 3 A and B. The average volumes of plankton at stations F, G, A, H, and I in the vertical hauls. May-August 1952 and June-July 1953.

the 50 and 100 m. hauls the average volumes are higher at station G than at station F, while in 1951 the highest figures were found at the outermost station.

In 1953 (Figure 3 B) the average volumes of plankton at the same stations during the

period 18th June—31st July are smaller than in the period May-August in previous years, with the exception of that at the outermost station.

The composition of the plankton at station A.

(a) during 1952.

At the beginning of May the young copepodite stages of *Calanus finmarchicus* constitute the greater part of the volume of plankton in the 50—0 m. hauls, but numerically *Oithona, Evadne* and Cirripede larvae predominate. The deeper hauls are characterized by a greater number of adults and older copepodite stages of *Calanus finmarchicus,* and of *Pareuchaeta norvegica, Chiridius armatus* and *Metridia* spp.

At the end of May, *Calanus finmarchicus* decreases in number and the smaller copepods *Microcalanus, Oithona* and *Oncaea* spp. are dominant. At the end of June there are also great numbers of *Acartia* and *Temora.*

At the beginning of July, *Calanus finmarchicus* again increases in number and at the middle of the month this species is dominant, the volume of plankton rising to the maximum for the year. Later in July copepodites and adults of *Calanus finmarchicus* still account for the greater part of the plankton volume, but the smaller species *Pseudocalanus, Temora, Oithona* and others now occur in greater numbers relative to *Calanus finmarchicus.* During August the number of *Calanus finmarchicus* declines, while the smaller copepods make up a still greater part of the stock, and at the end of the month they are the most abundant.

(b) during 1953.

In the middle of June the smaller copepods dominate, but some younger copepodites of *Calanus finmarchicus* also occur. In the deeper hauls we found the usual deep-sea copepods but not in great numbers. In the first half of July no essential changes had taken place in the plankton either in volume or in numbers.

At the end of July the smaller copepods, mainly *Pseudocalanus minutus,* still occur abundantly and in addition *Limacina retroversa* is present in quite large numbers.

The great increase in the volume of plankton which usually takes place in the fjords during July is possibly caused by an influx of water carrying rich plankton from the offshore areas. In July 1953 *Calanus finmarchicus* was scarce, and the usual increase in the volume did not occur.

The occurrence of *Limacina retroversa* at the end of July 1953 suggests that an inflow of offshore water had probably taken place, but that this water was evidently poor in plankton.

To summarize, 1953 differs from the other years in that there were only small numbers of *Calanus finmarchicus* and accordingly small plankton volumes during July.

Kaare R. Gundersen.

THE FISH

German Fishery Research Work.

The fishery statistics for 1953 show a heavy reduction in the German landings from the North-Eastern Area. They decreased to little more than half of those in 1952 and amounted to only 11 % of the total steam trawler catches against 20 % in the preceding year (Table 1). Agreements have been made between German trawler owners to avoid too large landings of small redfish and cod because of their bad condition and low prices. Also the weather has not been favourable. But the real cause of the diminution in the fishery seems to be in the biological situation. During recent years the usual catches of cod and haddock have become smaller and more irregular. As a compensation since 1950 increased catches of small redfish were possible, but now these too have diminished or, as mentioned above, have been fished less intensively.

The total decrease of 43 % in the landings was divided among the species as follows:— 15 % in haddock, 25 % in cod, 38 % in saithe, and 61 % in redfish.

Off the Norwegian north-west coast the fishing was especially poor in February, when the cod is usually at its maximum; and the period of rich saithe catches ceased earlier than usual. In comparison with former years the fishing effort in the Barents Sea was reduced in all months, although, quantitatively, the mean catches per fishing day were not essentially lower than before. In fact, the haddock catches were more than doubled in nearly all regions and all seasons of the year.

Table 1. German Fishery in the Area 1953, including Landings in Foreign Ports (Italics: 1952).

Fishing area	Norwegian coast (62°N.-22°E.)	Bear Island (N. of 72°N.)	Barents Sea (E. of 22°E.)	whole Area
Months	I—V, VIII—XII	V—VII	I, IV—V, XII	
Number of trips	302 *421*	43 *14*	39 *178*	384 *613*
» of fishing days	3074 *4380*	319 *123*	334 *1524*	3727 *6027*
Catch in 1000 tons	43.6 *70.5*	9.0 *2.0*	7.1 *32.5*	59.7 *104.0*
Mean catch per fishing day (100 kg.)				
Cod	28 *28*	127 *21*	57 *42*	43 *34*
Haddock	11 *10*	1 *2*	31 *9*	15 *10*
Saithe	67 *72*	2 *1*	9 *7*	51 *50*
Redfish	23 *42*	149 *129*	121 *156*	42 *68*
Other fishes	10 *10*	8 *4*	4 *6*	10 *12*
Total	139 *162*	287 *157*	222 *220*	161 *174*

Table 2. Length and Age Composition of the German Landings of Cod, Haddock and Redfish from Catches in the NE.-Area 1953. (Permille).

Species	Cod			Haddock			Redfish
Fishing area	Norw. coast	Bear Isl.	Barents Sea	Norw. coast	Finn-marken	Barents Sea	Bear Isl.
Months	II—IV[1])	V+VI	XII	II—IV[1])	V	XII	V—VI
Age-groups							
II	—	—	—	—	—	2	—
III	3	—	3	1	—	118	—
IV	5	3	122	12	—	201	—
V	68	**456**	236	**473**	—	**487**	—
VI	101	197	**289**	197	—	95	—
VII	94	107	146	149	—	43	—
VIII	**215**	103	94	67	—	18	—
IX	127	45	50	38	—	9	—
X	119	39	35	23	—	11	—
XI	75	23	11	12	—	4	—
XII	61	13	6	8	—	5	—
XIII	32	9	5	5	—	3	—
XIV	28	1	—	4	—	2	—
XV +	72	4	3	11	—	2	—
Length-groups (cm.)							
19—24	—	—	—	—	—	—	—
25—29	—	—	—	—	—	—	12
30—34	—	—	—	0	—	1	37
35—39	—	—	—	2	1	62	639
40—44	0	—	10	19	98	153	297
45—49	4	0	66	124	402	268	7
50—54	9	45	214	352	377	316	5
55—59	40	181	272	273	102	124	3
60—64	60	279	159	140	9	28	0
65—69	104	193	123	48	6	20	0
70—74	148	132	64	16	3	13	0
75—79	176	74	45	13	1	11	0
80—84	151	46	26	11	1	4	0
85—89	120	32	13	2	0	0	—
90—94	88	11	7	0	—	—	—
95—99	53	5	1	—	—	—	—
100—104	27	2	0	—	—	—	—
105—109	12	0	0	—	—	—	—
110—114	5	0	0	—	—	—	—
115—119	2	0	0	—	—	—	—
120 +	1	0	—	—	—	—	—
Mean size							
Length, cm.	79.3	66.9	60.8	56.2	50.3	50.5	39.0
Weight, gr.	3351	2004	1602	1393	960	1067	685

[1]) Unlike the report for 1952 including the last winterring.

This increase in haddock together with a minor increase in cod has almost compensated for the losses in redfish.

No fishing was carried out on the edges of the Spitsbergen Bank near Bear Island as occurs normally, but only farther south in the deeper parts of the Bear Island Deep. In May large numbers of redfish of about 40 cm. are taken (see Table 2). Then towards the end of the month greater quantities of cod appeared in the catches which at the beginning had a length of about 60 cm. while this increased, within the next few weeks, to about 80 cm. In order to maintain good yields of cod, the trawlers had to follow these migrating shoals approximately NE., in the deep water which extends to the east of the Spitsbergen Bank. The mean catches per fishing day during the fishing period were:—

	May	June	July	
Redfish.....	26.0	9.5	1.2	tons
Cod.....	6.3	17.4	10.6	»

In the cod samples from the Barents Sea the age-groups V and VI, i.e., those born in 1948 and 1947, varied in abundance from one sample to the next. However, the younger one was the more abundant in the Bear Island region as in the previous year. More than 50 or 60 % belonged to these two year-classes, and consequently the length distribution shows a strong peak at about 60 cm. Surprisingly, the 1945 year-class, 8 years old, was the strongest in the cod from the Norwegian coast. Until now, this year-class has not been prominent anywhere. The 1947 year-class is beginning to increase beyond normal.

Corresponding with the 1952 results, the 1948 year-class was absolutely predominant in the haddock landings from the Barents Sea being nearly 50 %. A similar abundance was noted for the first time in the catches from the Norwegian coast. This may be the main cause for the increased yields mentioned above. The length composition curve has a very narrow peak, which in the course of the last year shifted from about 45 cm. to 50 cm. in the Barents Sea catches and a few centimetres more on the Norwegian coast.

JOH. LUNDBECK.

North-Western Area.

INTRODUCTION

Contributions to this report have been received from:—

Denmark:
Mr. K. P. Andersen.
Dr. Paul M. Hansen.
Mr. Frede Hermann.
Mr. Jens Smed.

England:
Mr. G. C. Trout.

Iceland:
Dr. Árni Friðriksson.
Mr. Jón Jónsson.
Mr. Unnstein Stefánsson.

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Germany:
Dr. C. H. Brandes.
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Dr. G. Krefft.
Dr. Arno Meyer.

Scotland:
Mr. R. E. Craig.
Mr. R. Jones.
Mr. W. Main.
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Mr. Alan Saville.
Mr. E. Wilson.

This report deals mostly with hydrography and the various stocks of cod (about 40% concerns hydrography, about 40% cod, and only about 20% plankton and benthos research and all other commercial fish in the area—except herring which is well covered by the special herring report). The reports for the preceding years have shown a similar emphasis on these two very important items. It would, however, be of value for future research work and the industry if we could publish more information on fluctuations in the biotic environment in this area, and occasionally reviews of the stocks of various commercial fish species which have been more or less neglected for several years in this report, though much material has been collected by various vessels operating in the area. It is evident that the growing shortage of young scientists is the primary cause of this failure to be up to date.

Environment.

The **hydrographical** contributions are growing both in quantity and quality, owing to the increasing interest of the commercial fishery in northern waters and to the better opportunity for collecting hydrographic observations offered by an increasing number of research and other vessels. Most of the waters of the area are now sampled, at any rate once a year. We hope, however, that the routine sections over some fishing banks could also be operated in autumn and winter, and that routine sections showing major alterations in the oceanic circulation of the area could also be operated more frequently.

Surface anomaly studies show that in 1953 temperature in the area rose generally by about 0.7°C. (compared with 1876—1915); at the Faroe station the mean temperature was 0.8°C. higher than the mean for 1952. The boreo-arctic area south and south-east of Cape Farewell showed, however, a fall in temperature (the anomalies being —0.1 to —0.7) in 1953. Routine investigations in the various areas have been increased locally and the results show that the warmer period still continues, with local variations which can not yet be explained.

In the Faroe—Shetland Channel conditions were fairly normal in May—June, but in August the water transport was abnormally small.

The herring area east of Iceland and north of the Faroes was studied in May, June, August, September, and December and our knowledge of the variations is rapidly increasing; in a few years' time we may be able to give a general review of the conditions in this important area.

The conditions north of Iceland have also been studied for several years, but detailed seasonal studies are still required. The temperatures of the coastal surface waters north and north-east of Iceland in 1953 were above normal and much higher than in 1952, but in deeper layers the difference from 1952 was small. South-east of Iceland the warm tongue of Atlantic water was much less apparent in 1953 than in 1952.

In June—July the ocean between Faroes and East Greenland showed slightly higher temperatures in the east, as was the case also in 1952, compared with a decrease in 1950—51 after a period of high temperatures, when a temperature of 8° occurred down to 600—700 m. depth (1938, 1947 and 1948).

In West Greenland waters (including the northern part of the Labrador Sea) temperatures in the summer of 1953 were above normal and much higher than in 1952.

Off north-west Scotland hydrographic studies were begun in 1953, to see, *inter alia*, whether Otto Pettersson's internal tides hypothesis applied to this area.

Zooplankton researches were carried out by Scotland only and comprised sampling over

the area from Rockall—NW. Scotland—Orkney —Shetland to north-west over the Faroes to south and south-west Iceland, especially in summer, but also in February, April, and May. The most prominent feature was that by the summer the oceanic fauna was much more widespread and contained a much greater proportion of southern species than in recent years.

The Fish.

Eggs and Larvae. Estimation of abundance of larval stages of haddock in the Faroe area is based on two surveys only, but it seems that the brood of 1953 was only slightly inferior to that of 1952, which was intermediate between the broods of 1950 and 1951. On the cod-brood investigations are reported from West Greenland only where the brood developed early, the distribution was northerly about July, and post-larvae were few.

Cod. Age-assessment was carried out for the cod stock at Iceland and west of Greenland. For the first area Iceland and Germany have reported, and for the last, Denmark, Germany, Iceland, and Norway. Material for the analyses is procured by long-line, hand-line, and trawl, from coastal waters, offshore banks, and deep water.

In *Iceland waters* the spawning stock was dominated by the 1945 year-class, the 1942 year-class had fallen to 13%. The 1949 year-class promises well for the future.

In *West Greenland waters* the 1947 year-class now generally predominates in coastal waters and on the banks, except off Disko I., where the 1942 year-class predominates, and in south West Greenland, where the 1945 and 1947 year-classes predominate. The Norwegian investigations have shown that in deeper waters, viz., in the Holsteinsborg Deep, the 1942 year-class still predominates, but the 1947 year-class is increasing. A general decrease in age and size follows the increase of the stock.

Extensive tagging experiments were carried out; most recaptures came from the Greenland area, and only a few from Iceland, viz., about 14% as against 49—73% in 1933—1939.

Several observations on the influence of temperature on catch, on age at first maturity, etc., are recorded.

Haddock. Surveys of the haddock stocks were made for Faroe and Faxa Bay. In the *Faroe area* the 1948—51 year-classes predominate in the commercial catches. The mortality rate of all broods is 49% for the period 1952—53, and a special report on this problem is now being prepared. The average commercial catch per 100 hours in 1953 was 140 cwt. (against 125 and 126 in 1951 and 1952).

A very important survey in *Faxa Bay* shows the enormous effect of the closure of the Bay to trawling and seine-netting begun in 1952. Compared with earlier results (see Rapp. et Proc.-Verb. **120**) in 1953 there were 40 times more haddock by weight on the territorial station and 100 times more on the extra-territorial station. This survey is the most important contribution to the area report this year, and the final report on all species will have an important bearing on all studies of the effect of area closure on protection of fish stocks.

Saithe. For North Iceland information is given on the stock composition, compared with the years 1950—52. The rich 1945 year-class has emigrated and no good year-classes have replaced it.

Lemon Sole. A report has been given on this species only for the *Faroes*. The fishing effort of Aberdeen trawlers has declined by 25% in the last two years, that of English trawlers by 28%, but notwithstanding this decline the average catch of lemon sole (not of haddock, cf. above) per unit of fishing has continued to fall from 14—15 cwt. per 100 hrs. fishing in 1951—52 to 10 cwt. in 1953. The 1946 brood is still predominant, followed by those of 1948 and 1947, but since 1946 the recruitment has been poor.

Redfish. On this increasingly important species for 1953 we have only a report from west Icelandic waters. Measurements from commercial catches are available for March, September, and October. The percentage of the category "small" (< 40 cm.) was low in 1950, 51, and 53, but very high in 1952. Owing to insufficient material for every season and year it is not yet possible to decide from measurements alone whether this fluctuation is due to seasonal migration in the area or to fluctuations of year-classes. Some samples of very small redfish rejected from trawl catches seem to show that year-class fluctuations may be of importance. It should be emphasized that age-determinations become more and more important for the study of this species in the various areas, and it is desirable that detailed studies of a comparative nature be carried out in all northern waters.

Rare Fishes. Reports are given by Germany and Scotland.

Å. V. Tåning.

ENVIRONMENT

Hydrography.

Monthly Anomalies of the Surface Temperature in Areas of the Northern North Atlantic in 1953.

On the basis of data collected in 1953 by the Danish Meteorological Institute from Danish and Icelandic ships in the northern North Atlantic anomalies of surface temperature have been evaluated for each month and each 1°-square, using RYDER's grand monthly means for the period 1876—1915 as standards. These anomalies were then averaged over the areas indicated in Figure 1.

The results are given in Table 1 A where the monthly anomalies are recorded together with the numbers of observations on which they are based. In the last column of the table the monthly anomalies for each area have been averaged over the year.

Table 1 A shows that positive anomalies are predominant in all the areas except N. The distribution of the anomalies over the whole region is seen from Figure 2 where the yearly anomalies, given in the last column of Table 1 A, have been entered. The figure shows that the highest anomalies are found in the north-eastern part of the region and in area A.

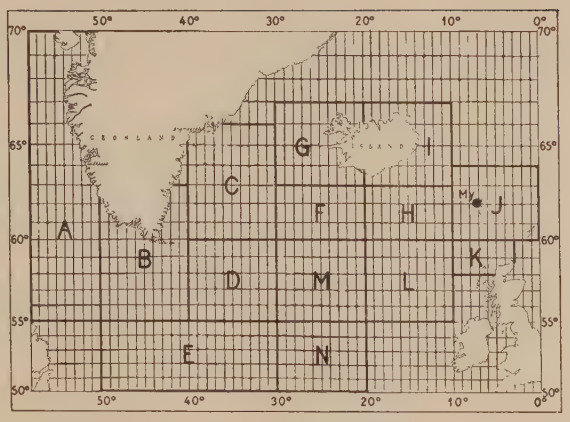


Figure 1. Location of areas and station My.

The average of the yearly anomalies given in the last column of Table 1 A is about 0.7 °C. against 0.35 °C. in 1952. However, the rise of temperature since 1952 varies much from one area to another. In some areas the temperature has even fallen. The geographical

Table 1 A. Monthly Anomalies (△ °C.) and Numbers (n) of Observations of the Surface Temperature in the Areas A-N (see Figure 1) during 1953.

Area	Jan. △	Jan. n	Feb. △	Feb. n	March △	March n	April △	April n	May △	May n	June △	June n	July △	July n	August △	August n	Sept. △	Sept. n	Oct. △	Oct. n	Nov. △	Nov. n	Dec. △	Dec. n	Average of △-val.
A....	—	—	—	—	—	—	2.2	10	1.5	52	1.0	68	1.1	178	0.7	122	1.4	97	0.7	63	0.5	10	—	—	1.1
B....	—	—	—	—	–1.3	36	0.9	101	1.6	93	0.8	103	0.2	144	0.1	131	0.0	49	0.2	98	–0.9	55	0.5	5	0.2
C....	—	—	—	—	–0.6	34	0.2	41	1.0	58	0.9	72	1.3	118	0.9	78	0.6	35	0.5	64	0.6	6	1.5	1	0.7
D....	2.4	10	—	—	–0.6	42	0.5	52	1.1	63	0.6	46	0.2	32	–0.2	43	0.2	47	–0.1	45	–0.4	30	0.3	8	0.4
E....	3.1	37	1.5	11	0.8	7	0.8	24	0.9	33	0.4	40	0.4	26	0.0	59	–0.2	50	–0.2	60	–0.2	34	1.3	57	0.7
F....	–0.7	3	–0.4	1	0.1	46	–0.4	97	0.5	78	0.6	103	1.3	80	0.5	80	0.7	49	0.8	56	0.2	32	0.2	31	0.3
G....	0.2	10	1.8	15	1.0	14	–0.6	15	0.8	14	1.1	16	1.4	28	1.1	21	0.6	24	0.7	27	0.6	30	0.7	9	0.8
H....	0.9	34	0.8	45	0.8	90	0.1	139	0.5	100	0.9	155	1.1	123	1.0	162	1.2	128	0.7	113	0.7	87	1.0	57	0.8
I.....	1.1	7	0.9	5	1.0	4	–0.7	13	0.5	6	1.7	22	1.5	10	2.3	8	2.7	6	1.1	6	1.9	9	2.5	3	1.4
J....	0.5	42	1.1	35	1.0	54	0.5	89	0.9	65	0.3	126	0.8	68	0.8	108	1.0	83	1.0	63	0.8	85	1.3	42	0.8
K....	0.3	29	0.4	36	1.2	36	0.6	55	0.7	47	0.5	69	0.4	63	0.5	73	0.7	59	1.3	54	1.1	57	1.6	28	0.8
L....	1.4	26	1.0	20	1.2	26	0.2	42	0.5	32	0.7	36	1.0	38	0.6	38	0.9	27	1.0	43	0.5	54	0.8	20	0.8
M....	2.1	27	1.6	15	–0.1	15	0.0	43	0.7	34	0.9	33	0.9	38	0.1	55	0.4	47	0.0	56	0.1	47	0.6	20	0.6
N....	—	—	—	—	—	—	–0.3	9	—	—	—	—	—	—	—	—	–1.0	6	—	—	0.2	6	0.9	5	0.0

Table 1 B. Grand Monthly Means of the Surface Temperature (°C.) at Myggenæs, Faroes (My in Figure 1), during the Period 1914—50 and Deviations for 1953 from these Means.

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Means 1914—50.....	6.3	6.0	5.9	6.3	7.1	8.2	9.3	9.8	9.7	9.1	7.9	7.0
Deviations 1953.....	0.1	–0.1	1.0	0.7	0.5	0.0	0.0	0.1	0.2	0.5	1.0	1.2

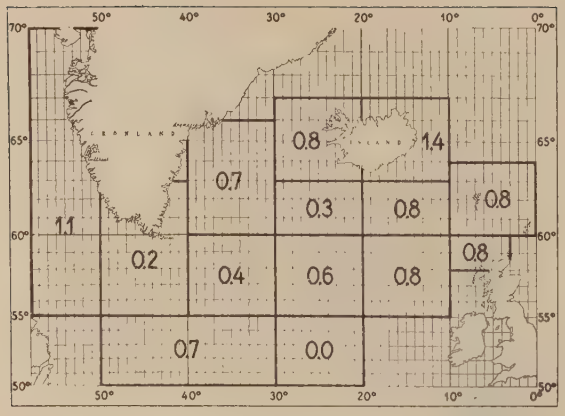


Figure 2. Yearly anomalies of surface temperature (°C.) for 1953.

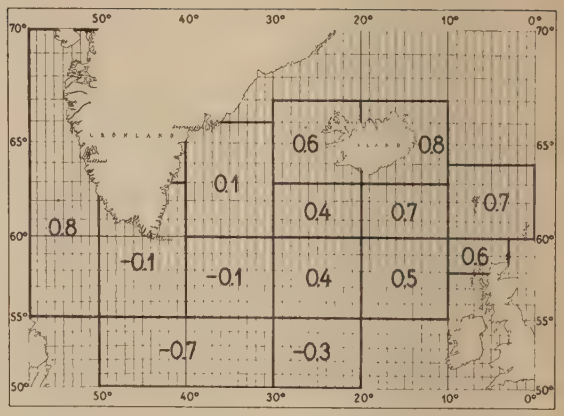


Figure 3. Rise of temperature (°C.) from 1952 to 1953.

distribution of the temperature rise since 1952 is shown in Figure 3.

Table 1 B gives grand monthly means of the surface temperature at Myggenæs, Faroes (station My in Figure 1), during the period 1914—50, together with deviations for 1953 from these means, based on data received from the Danish Meteorological Institute. The mean temperature for 1953 is 0.8 °C. higher than the mean temperature for 1952. This accords well with the result found above that the temperature in area J has risen 0.7 °C.

For placing data at my disposal I am greatly indebted to Messrs. I. Sestoft and H. Thomsen of the Danish Meteorological Institute.

Jens Smed.

A first Study of the Detailed Hydrography of some Scottish West Highland Sea Lochs (Lochs Inchard, Kanaird, and the Cairnbawn Group).

Introduction.

The object of this investigation is (a) to test whether there is any clear hydrographic difference between those lochs which hold adult herring, and those which do not, and (b) to test whether the internal tide hypothesis of Otto Pettersson has application to the area. Work is being done at present as a hydrographic study, though biological investigations of the lochs are being carried out simultaneously. The position of the lochs surveyed is shown in Figure 4.

Single detailed surveys were made in October—November 1953, including observations of temperature and salinity, with oxygen and free phosphate at selected stations. The conditions are shown in Figure 5. To make for clearer presentation, the salinities are plotted as Defined Coastal Influence (D. C. I.) which is defined as $1 + \mathrm{Log}_{10}\ (35.5 - S^0/_{00})$. (This method allows the detail to be shown with roughly equal precision in areas of both great and small dilution, without introducing arbitrary and abrupt changes in the spacing of the isolines. The method is described in detail in a note elsewhere, North Sea, pp. 86—89).

A notable feature is the presence in the basins of Loch Inchard and Loch Kanaird of bodies of stagnant water, relatively cold, deficient in oxygen content, and rich in phosphate.

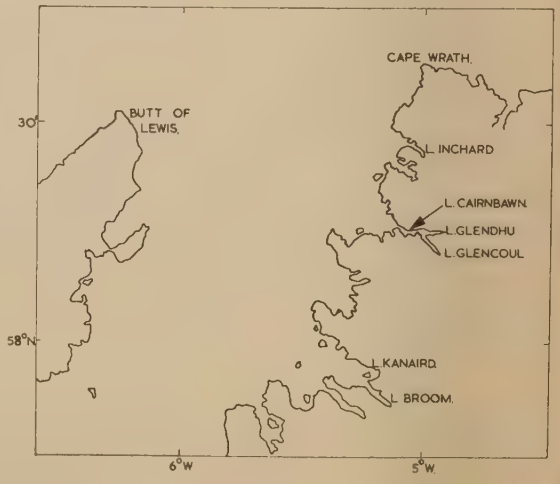
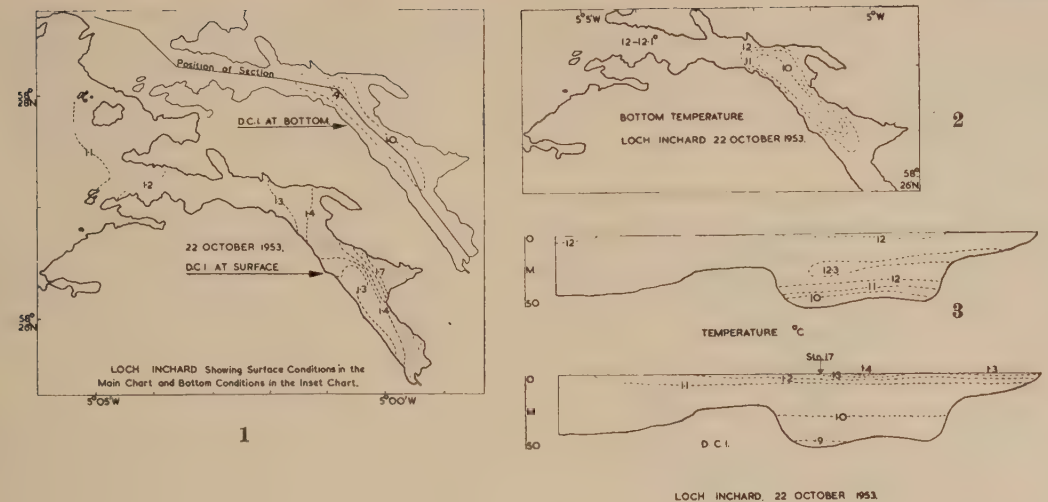
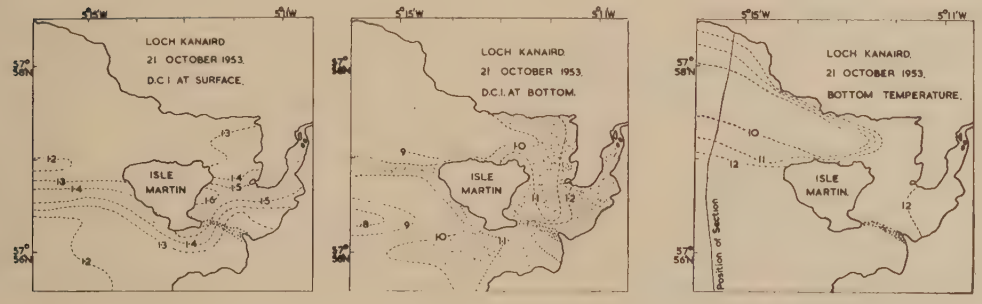


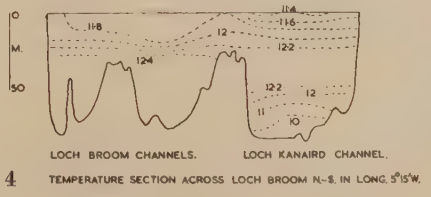
Figure 4. The N. Minch, showing L. Inchard, the Cairnbawn group which includes L. Cairnbawn, L. Glen Dhu, and L. Glen Coul, and Lochs Kanaird and Broom.

a



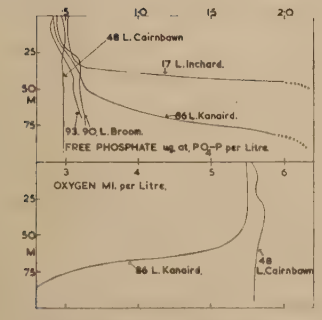
b





b 4 TEMPERATURE SECTION ACROSS LOCH BROOM N–S. IN LONG. 5°15'W.

c



VERTICAL DISTRIBUTION OF PHOSPHATE AND OXYGEN AT SELECTED STATIONS.

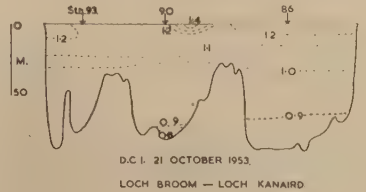


Figure 5. October 1953.

(a) Hydrographic conditions in L. Inchard.
(b) Hydrographic conditions in L. Kanaird.
(c) Vertical distribution of free phosphate and oxygen at selected stations.

This water type did not appear in the Loch Cairnbawn system, and the reasons for this difference have not yet been discovered. All the lochs have a deep basin and their entrances are of a lesser depth.

Flushing times.

An approximate value of the flushing time for each loch has been made, using data supplied by Dr. J. Glasspoole of the British Meteorological Office. These figures are of the estimated run-off to each loch during October, based on the observed rainfall and making allowance for the expected evaporation from the land. For the purpose of this report, this was simply converted to a mean daily rate.

If the salinity in a loch or estuary is lower than that of the sea water immediately outside, then the difference will be due to fresh water flowing in from the surrounding land. The total volume of this locally derived fresh water in the loch at any time is determined, and compared with, the observed rate of inflow of fresh water. If the loch or estuary contains X day's inflow, we say that the flushing time in these conditions is X days, and we infer that a general change-over in the water of the loch must take place in about that time. One cannot be very precise about this, since it will be evident that water from a river may flow outwards in one particular region of a loch, leaving another part, or water at a different level virtually unchanged for a time. Some indication of this may be looked for in the distribution of salinity. In making the calculations for these particular lochs, the stagnant water in the deep basins has been ignored. A single example of the calculation is given.

Loch Inchard.

Area of loch = 4,000,000 sq. metres.

Approx. mean depth to level of stagnant water = 25 m.

i. e., volume of non-stagnant water $= 100 \times 10^6$ m^3.

Mean salinity of non-stagnant water in loch $= 34.02\,^0/_{00}$.

Typical value for salinity of sea immediately outside loch $= 34.40\,^0/_{00}$,

i.e., percentage of locally derived fresh water in loch $= \frac{34.40-34.02}{34.40} \times 100 = 1.1\,^0/_0$,

i.e., volume of locally derived fresh water in loch $= 1.1 \times 10^6$ m^3.

mean daily run-off (Oct. 1953) $= 0.19 \times 10^6$ m^3.

i.e., flushing time $= \frac{1.1}{0.19} = \underline{6 \text{ days.}}$

For the other lochs surveyed the following estimates of flushing time have been made.

Loch Glen Dhu	c. 1 day
Loch Glen Coul	c. 3 days
Loch Cairnbawn system	c. 4½ days
Loch Kanaird	c. 2½ days

In the case of Loch Kanaird, the estimate is probably low for the main part of the loch, since the salinity distribution suggests a considerable outflow of the River Kanaird over the shallow sill connecting Isle Martin to the mainland.

Stagnant deep water.

As chemical resources were limited, it was intended to restrict oxygen sampling to the Loch Cairnbawn system for which the most detailed survey was planned. This survey was the last to be carried out, and it was apparent that this loch differed from the other in having *no* stagnant zone. A few oxygen samples were made later in Loch Kanaird and produced the results expected from the other observations. This bottom water is characterized as follows. Temperature = c. 9½°C., D.C.I. = 0.9 ($34.7\,^0/_{00}$), oxygen = 2.6 ml./l., i.e., about half the value outside the sill. Free phosphate $>2\mu$g.at./l., i.e., more than four times the value outside the sill. It seems likely that the Loch Inchard bottom water is of similar type, though no oxygen values were obtained here.

Chart sections and graphs.

The following are presented:—

Figure 5(a). Loch Inchard. D.C.I. at surface and bottom, temperature at bottom, and temperature and D.C.I. sections along the centre line of the Loch.

Figure 5(b). Loch Kanaird. D.C.I. at surface and bottom, temperature at bottom, and temperature and D.C.I. sections across the entrance to Loch.

Figure 5(c). Vertical distribution of oxygen stations 48 and 86. Vertical distribution of free phosphate stations 17, 48, 86, 90, 93. Station 48 is in the deep basin of Loch Cairnbawn. Station 17 is indicated on the Loch Inchard section. Stations 86, 90, 93 are indicated on the Loch Cairnbawn/Broom section.

Conditions not illustrated.

Temperature in the lochs, c. 11.8° at surface rising to c. 12.2° at 50 metres depth, except in stagnant water.

D.C.I. A pattern dependent largely on the local run-off, and typified by those illustrated.

Oxygen. Values c. 5.4 to 5.6 ml./l. except in stagnant water.

Free phosphate. Values c. 0.47 to 0.75 μgm. at./l. except in stagnant water.

Admiralty charts.

Since these lochs are perhaps not widely known, it may be helpful to quote the charts available. These are 2500, 2502 and 2503.

R. E. Craig.

Figure 6. Hydrographic conditions in the northern approach to the Irish Sea, October 1953.

Temperature and Salinity in the Northern Approach to the Irish Sea.

During October 1953 a study (reported by Mr. I. G. Baxter, this volume, Herring, p. 163) was made of this area to find the distribution of larval and post-larval herring. Temperature and salinity observations were made at surface and bottom at sixty-seven stations, and the results are indicated in charts (Figure 6).

The salinities are presented in the form of D.C.I. (Defined Coastal Influence) which depends on salinity as follows: D.C.I. $= 1 + \text{Log}_{10}\ (35.5\text{-S}^{0}/_{00})$. (This method allows of reasonable detail being shown in both oceanic and coastal areas, without introducing arbitrary and abrupt changes in the intervals of the isolines, and is explained in detail in this volume, North Sea, pp. 86—89).

It is undesirable to generalize from a single survey of this kind, but a few features are worth mentioning.

Temperature. The North Channel has uniform conditions, and the contrast between the marked rise in the Solway Firth and the marked fall in the Firth of Clyde is of interest. While the greater depth of the Clyde is no doubt a factor in this, it is difficult at present to give a fair account of the mechanism. The lower temperature of the oceanic intrusion is also significant.

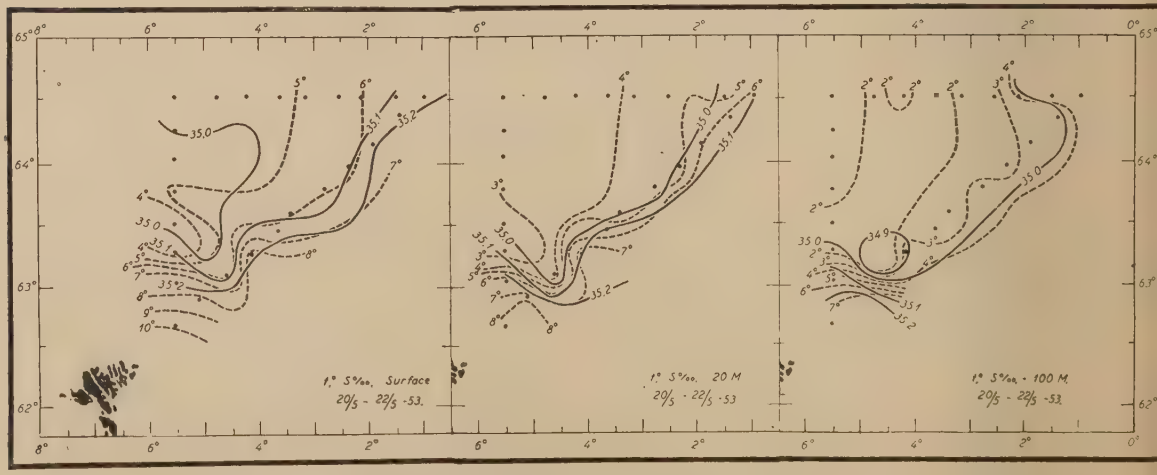
D. C. I. The most striking feature is the almost undiluted oceanic thrust from south of west almost reaching Dubh Artach (indicated by ⁜ on the charts). Conditions round the Irish coast are consistent with a drift round the north of Ireland into the Irish Sea, but this can in no sense be regarded as an oceanic intrusion, the D.C.I. value of 1.0 corresponding to $34.5^0/_{00}$ evidently contains about 2 to $3^0/_0$ land run-off water, and is thus typically coastal in its character.

R. E. Craig.

Hydrographic Conditions in the Southern Part of the Norwegian Sea, 1953.

The 1953 Danish investigations in the southern Norwegian Sea were, as in the preceding years, concentrated on the herring area north-east of the Faroes and the Faroe-Shetland Channel. The main bulk of the observations were in June, when the R/V "Dana" under the leadership of Dr. E. Bertelsen was working in the area; but we also have observations from May, August, September, and December, as the fisheries inspection ship "Thetis", under the leadership of Commander Bonnek, took observations in the first three months, and the M/C "Vördan", under the leadership of Dr. E. Bertelsen was working in the area in December.

This year we again found a sharp limit between the cold East Icelandic Current and the warm Atlantic water, and the limit again had an exceedingly complicated geographical course. These observations are shown in Figures 7—19, which show isotherms and isohalines for the depths 0, 20 and 100 m. From the Figures 10—12, which show the conditions in June, it can be seen that the boundary results from the fact that a warm Atlantic tongue crossed the Faroe-Iceland Ridge and divided the East Icelandic Current into two tongues. The most eastern and largest of these tongues is found again in the figures of the other months. It is seen that the position and extension of the tongue varied a little from time to time, but that all in all it was rather constant. It is difficult to say anything certain regarding the time for the greatest extension of this eastern tongue from the figures shown here, but there are indications that the extension of the tongue



Figures 7—9. Temperature and salinity, May 1953.

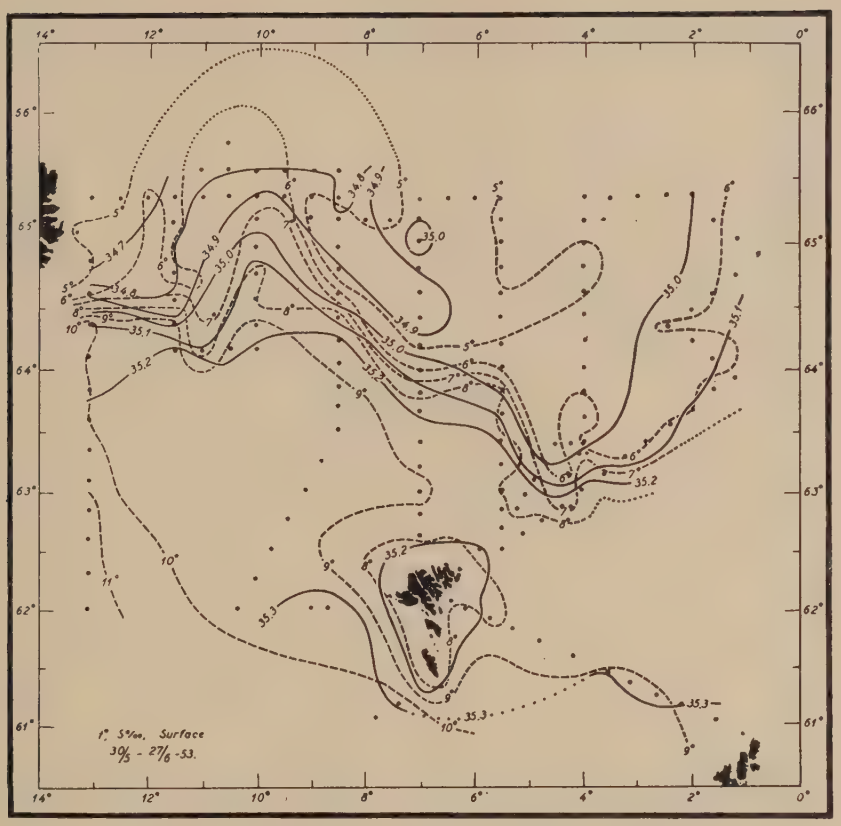


Figure 10. Temperature and salinity at surface, June 1953.

was perhaps greatest in spring. The eastern limit of the tongue was rather indistinct, and it is obvious that a mixing had taken place with the warm Atlantic water coming through the Faroe-Shetland Channel and north of the Faroes.

The R/V "Dana" worked sections in this channel twice in 1953, viz., firstly on 30/5—1/6 and secondly on 21/8—23/8. These two sections are shown in Figures 21—22. The conditions in May—June were almost normal. Dynamical calculations showed that the water transport was also about (a little more than) normal, viz., 15.8 km.^{3}/hour, but conditions were rather abnormal in August. Here dynamical calculations gave a water transport of 5 km.^{3}/hour. The zero level used in both cases was the bottom for depths less than 800 m., and the isobaric surface at 800 m. for depths greater than 800 m.

Figure 23 shows a section along 5°30'W. in June. Here the conditions were normal and we see again the sharp limit.

Figure 20 shows the phosphate content in μg.at./litre in June at 0 and 20 m. depths. We see that there was a certain connexion between temperature and salinity on the one hand, and phosphate content on the other hand. The warm Atlantic water was mainly rich in phosphate, but the cold water from the East Icelandic Current was not.

A comparison with results of the investigations in preceding years shows that the conditions in the area in question are rather uniform from one year to the next, despite minor differences. In 1952 we also found that a warm

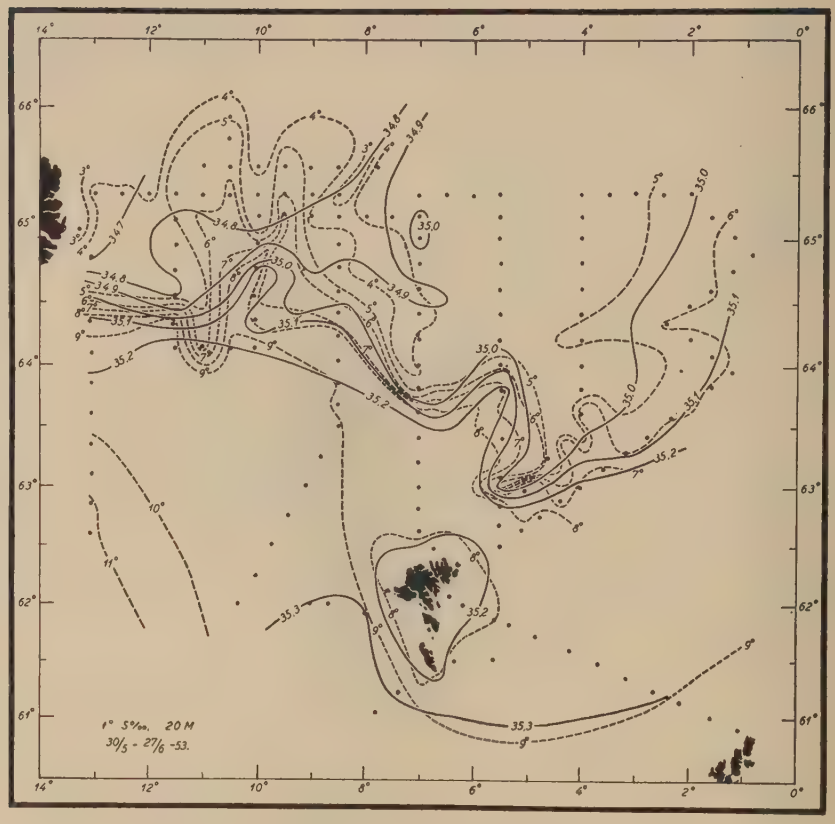


Figure 11. Temperature and salinity at 20 m., June 1953.

Figures 13—15. Temperature and salinity, August 1953.

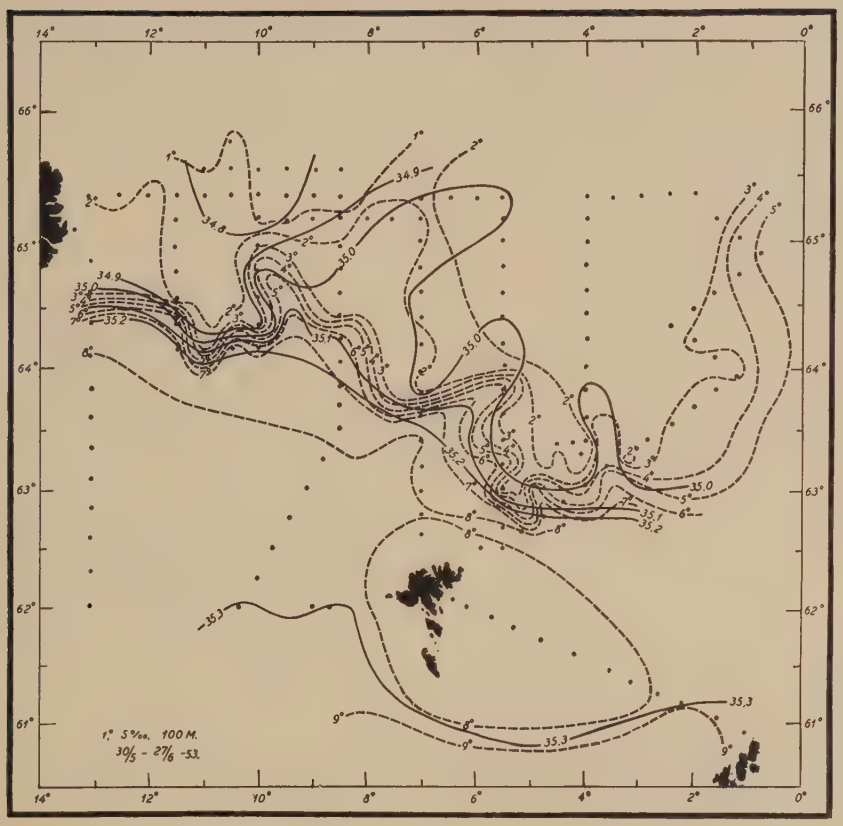


Figure 12. Temperature and salinity at 100 m., June 1953.

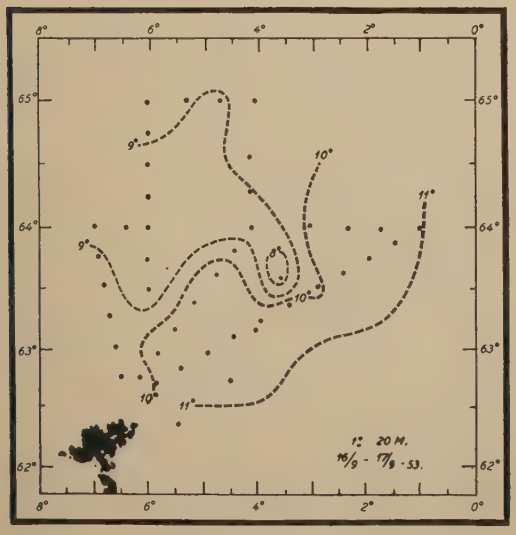


Figure 16. Temperature at 20 m., September 1953.

tongue crossed the Faroe-Iceland Ridge and divided the East Icelandic Current, although in 1952 it crossed near Iceland, whereas in 1953 it crossed near the Faroes. Such a change in the position of the crossing can have an influence on the herring shoals, as we often find the greatest quantities of herring near the boundary between the cold and the warm water. There was also a difference in temperature in the area of the East Icelandic Current, as the surface temperature was higher in 1953 than in 1952, whereas the temperature in the 50 to 100 metre layer was lower in 1953. On the whole, however, general outlines are similar from one year to the next, and certain points in the structure of the boundary indicate that this is closely determined by the bottom contours.

K. P. Andersen.

Figures 17—19. Temperature, December 1953.

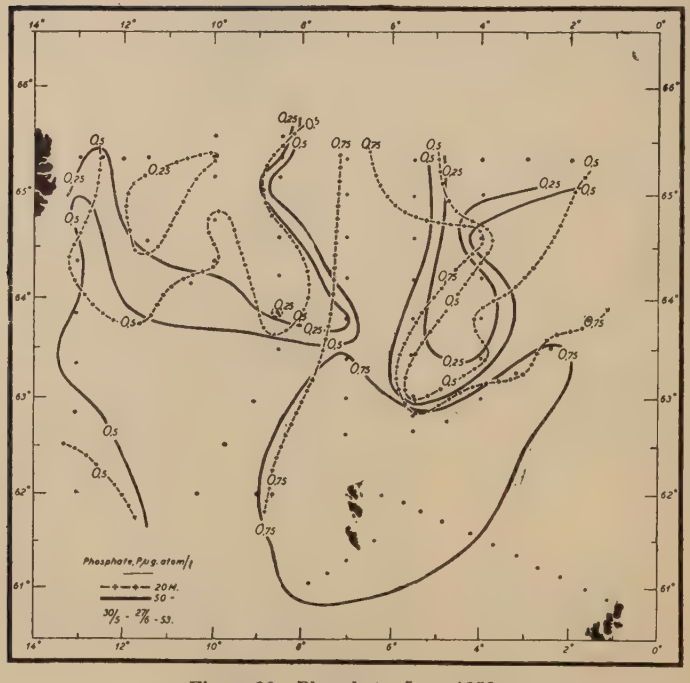


Figure 20. Phosphate, June 1953.

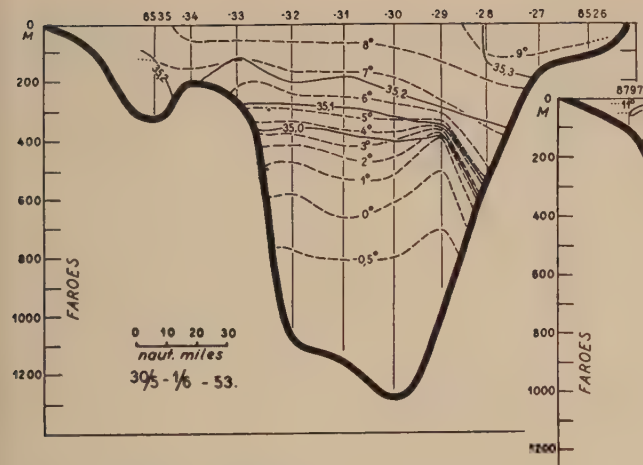


Figure 21.
Faroe—Shetland section, 30. May to 1. June 1953.

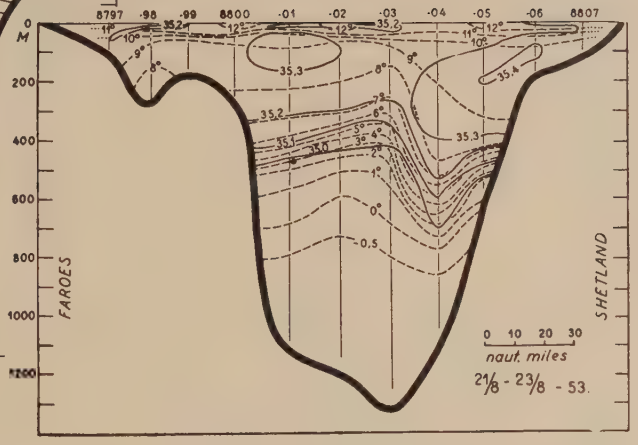


Figure 22. Faroe—Shetland section, 21. to 23. August 1953.

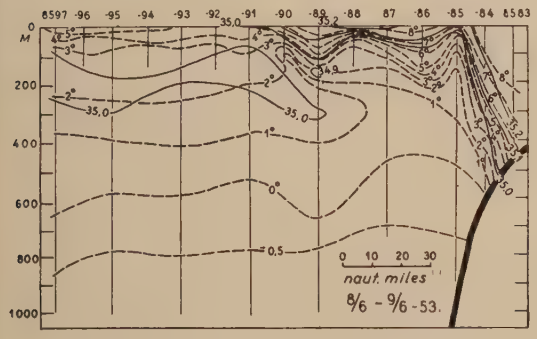


Figure 23. Section along 5°30′W., June 1953.

Hydrographic Conditions North and North-East of Iceland, 1953.

During June 1953 the usual hydrographic survey was made of the waters north and north-east of Iceland. These investigations were carried out from the Icelandic research vessel "Maria Julia" (Figure 24).

The temperature and salinity distribution at various depths is shown on Figures 25—27. This year the ice limit was found only 20 nautical miles off Kögur on the north-west coast of Iceland, as compared with more than 80 miles offshore at nearly the same date in 1952. The nearness of the drift ice is also indicated in the farthest north part of the section off Siglufjördur (Figure 28) where polar water was observed in the surface layer in contrast to previous year's experience.

In the Icelandic coastal area the surface temperature was above normal and much higher than in 1952. A marked thermocline was present between 20 and 30 metres and it was particularly well developed off the north-east coast (Figure 29). At 50 and 100 metres, however, the temperature was no higher than in the previous year, and the course of the isohalines indicated a less pronounced and probably somewhat later influx of Atlantic water. At depths below 200 metres (see Figure 28) the temperature was slightly higher in 1953 than in 1952, probably resulting from a less intense winter cooling during the winter 1952—1953 than during the previous winter.

In the middle part of the region between Iceland and Jan Mayen the surface temperature was also distinctly higher than in 1952, but at 50 metres, lower than in 1951 and 1952, as is clearly seen from the course of the 0°- and 1°-isotherms. At this level the arctic water has thus had a greater extension in 1953. Just south and south-east of the Jan Mayen bank, the conditions were similar to those of preceding years. At 100 m. and deeper (Figure 29) the hydrographic features between Iceland and Jan Mayen were essentially the same as shown by previous year's observations.

East and south-east of Iceland the hydrographic conditions were rather unusual when compared with earlier years. Thus the tongue

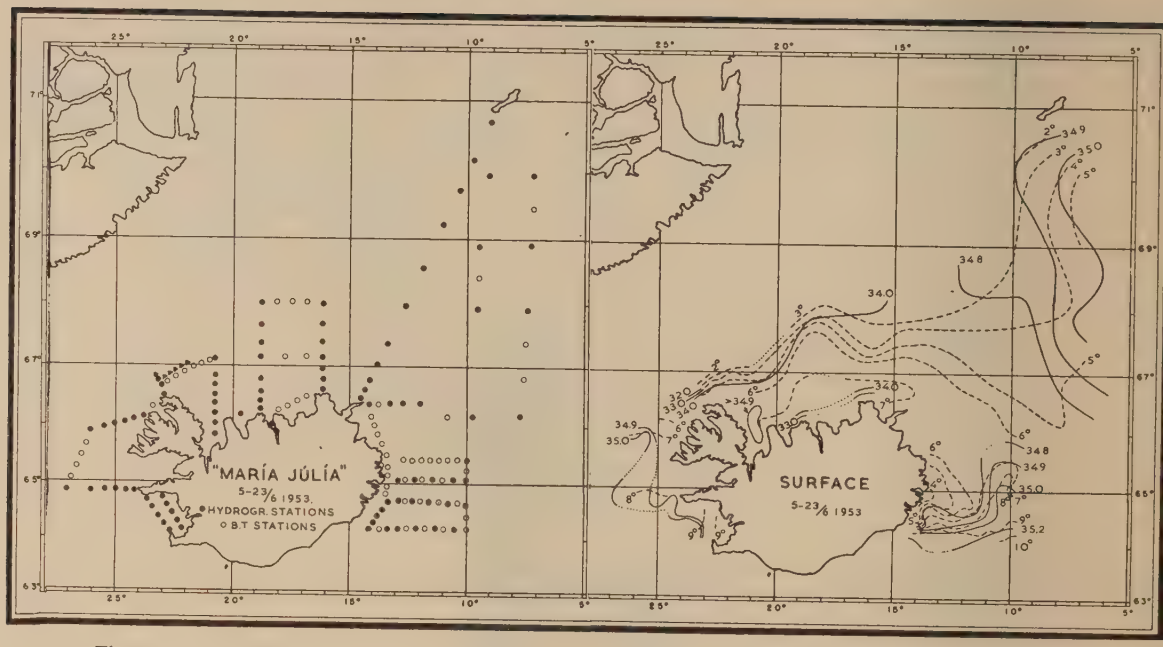


Figure 24. Location of stations—June 1953.

Figure 25. Temperature and salinity at surface.

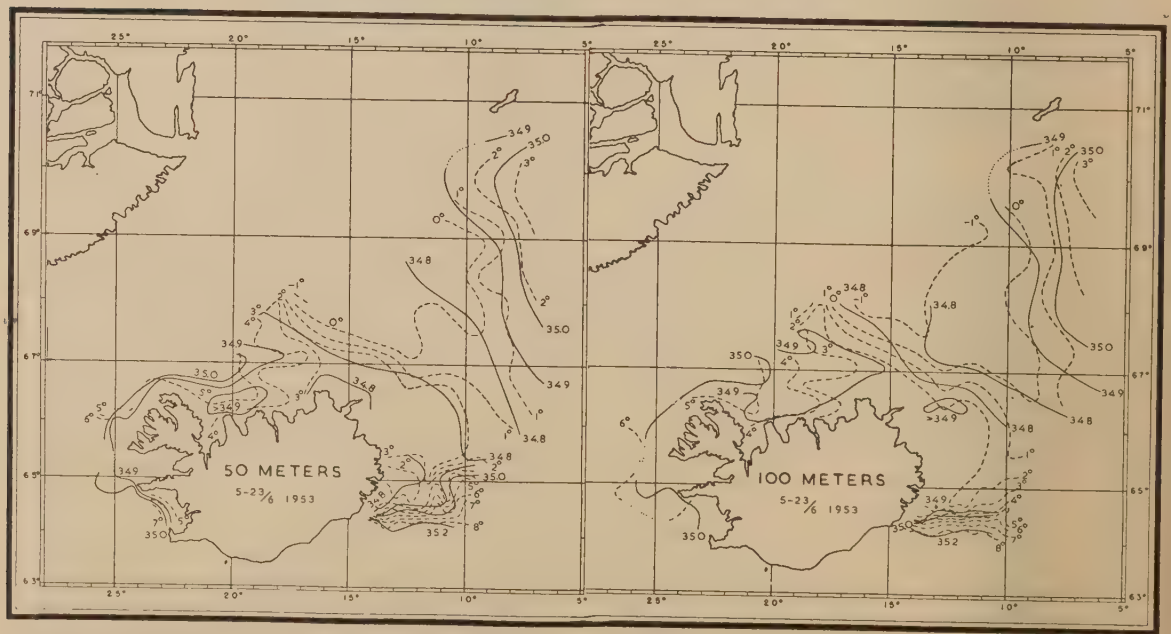


Figure 26. Temperature and salinity at 50 m.

Figure 27. Temperature and salinity at 100 m.

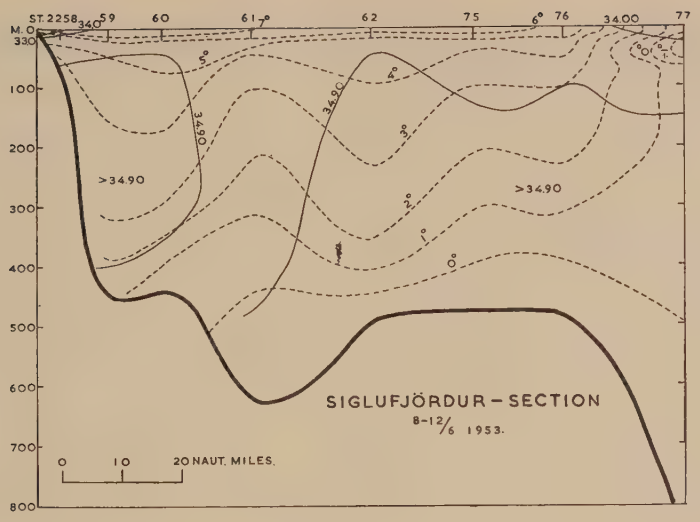


Figure 28.

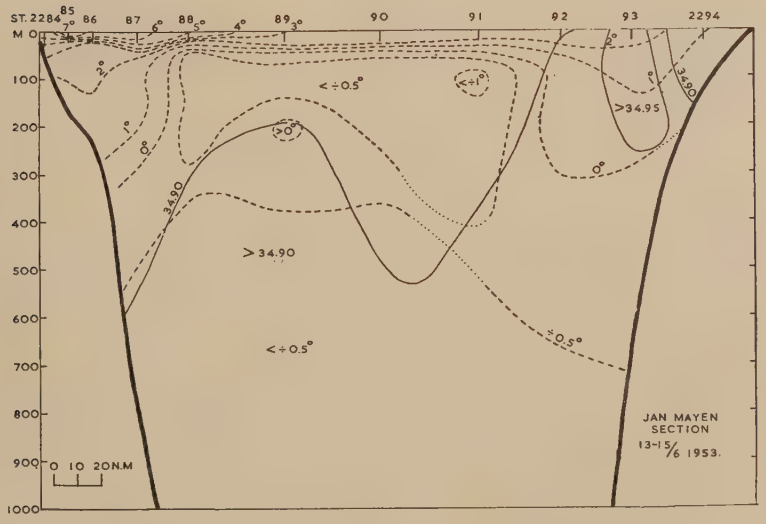


Figure 29.

of Atlantic water extending to the north near 65°—66° N. and 10°—11° W. was much less apparent in June this year.

In September when observations were repeated in the coastal area, the Atlantic water had extended over the entire area, all the way to the east of Langanes on the north-east coast. In the section off Siglufjördur the Atlantic water had, at that time, penetrated to more than 300 m. depth where the temperature was above 5 °C., and east of Langanes temperature values of more than 4 °C. were observed at 200 metres.

Unnsteinn Stefánsson.

Section from the Faroes to East Greenland along 62° N.

As in previous years, a section (Figure 30), was worked from the Faroes to East Greenland along 62° N. The western part of this section had previously been worked in years 1938, 1948, 1950, 1951, and 1952 from late June to the beginning of July.

In Ann. Biol. 1951, it was described how the temperatures had been decreasing in the upper 800 metres since 1948 in the eastern part of the section. Since 1951 the temperatures have again increased in the upper layer, between

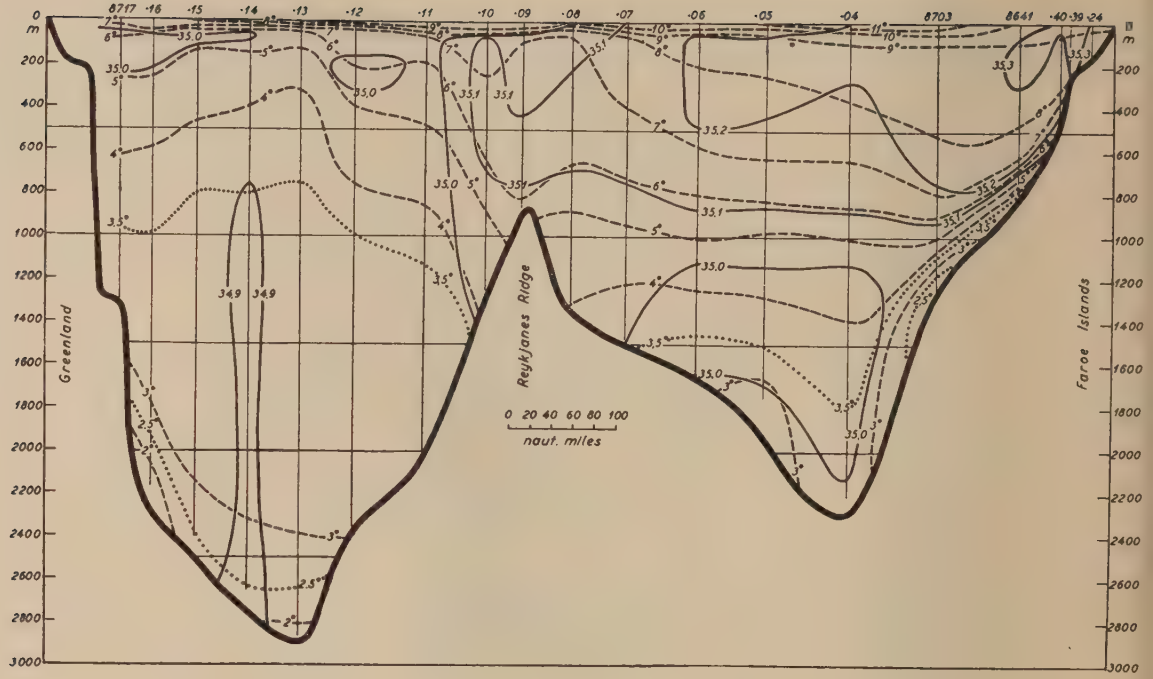


Figure 30. Section from the Faroes to East Greenland along 62°N. 19/6.—2/7. 1953.

10 °W. and 22 °W., and in 1953 they were, in the upper 400 metres, between 0.3 °C. and 0.6 °C. higher than those found in 1951. Below 600 metres, the water layers had about the same temperatures as in 1951.

Off the eastern slope of the deep basin east of the Reykjanes Ridge, cold water with salinities above 35‰ was found. This water must originate from the deep water of the Norwegian Sea which has flowed across the Faroe-Iceland Ridge and mixed with Atlantic water.

Over the largest part of the deep Irminger Sea we find the nearly homogeneous water originating from the Labrador Sea, with temperatures between 3° and 4° and salinities below 35‰. The north-going Irminger Current is found over and west of the Reykjanes Ridge, and two south-going branches of the same current are found at station 8712 and off the slope of East Greenland with salinities above 35‰. The amount of Atlantic water with salinities above 35‰ was smaller than that found in the years 1948, 1950, and 1952.

The westernmost part of the section was not completed, so no information is available about the state of the East Greenland Polar Current.

Frede Hermann.

Hydrographic Conditions in the Eastern Part of Labrador Sea and Davis Strait, 1953.

During July 1953 the hydrographic stations shown in Figure 31 were worked by the Danish R/V "Dana".

The temperature distribution at 50 metres is given in Figure 31 and shows that the arctic component of the West Greenland Current was very weak and its water masses off south-west Greenland were restricted to a narrow strip over the banks.

The warm Irminger Current was well developed, its core was found off the slope of the banks with temperatures above 6°, northwards to the Frederikshåb section and above 4° northwards to the Fylla Bank section.

From south-west Greenland a tongue of the warm water stretched south-westwards towards 56° W. Long., where it met the cold water masses of the Labrador Current.

North of the Fylla Bank section (II) the Irminger Current is present mainly as an undercurrent. Relatively warm conditions prevailed also over the northern banks.

Phosphate determinations were carried out in the upper 100 metres. Figure 32 shows the

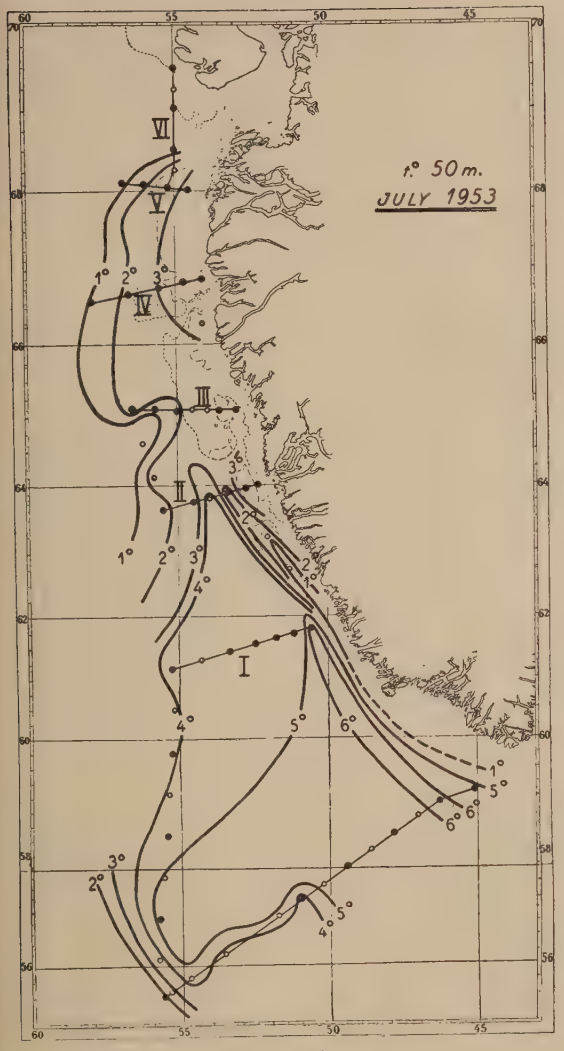


Figure 31.

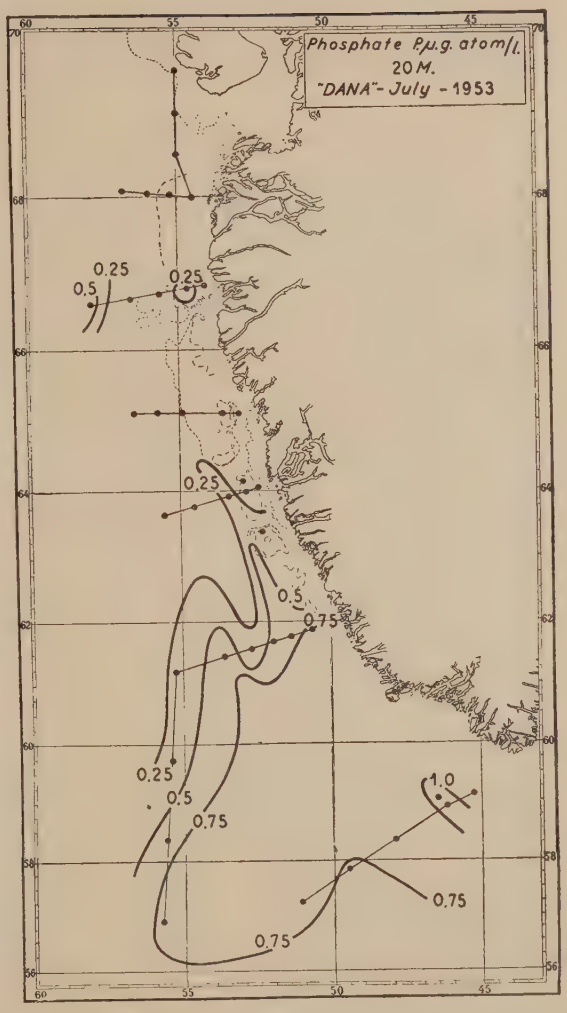


Figure 32.

distribution of phosphate at 20 metres. It is seen that many of the general features from the temperature distribution are also found in the phosphate distribution.

Thus the highest concentrations of phosphate are found off the slope, i.e., at the same locality as the core of the warm current. The most probable reason for this phenomenon seems to be that the turbulence in the strong current causes vertical mixing, which carries phosphate-rich deep water to the upper layers. From here the warm and phosphate-rich water spreads out in a tongue towards the south-west.

Northwards to Fylla Bank good conditions should thus prevail for plankton production off the western side of the banks. In the northern part of the area only small concentrations of phosphate were encountered except on the westernmost station of section IV, which is lying at the boundary of the Canadian Polar Current.

The conditions are further illustrated by the vertical sections I to VI, the location of which is shown on Figure 31. In all the sections the temperatures are above normal and considerably higher than those found in 1952. Thus, over the shallow part of Fylla Bank the temperatures were 1.5° to 2° higher and west of the bank in the upper 100 metres even 2° to 3° higher than the temperatures found in July 1952.

Frede Hermann.

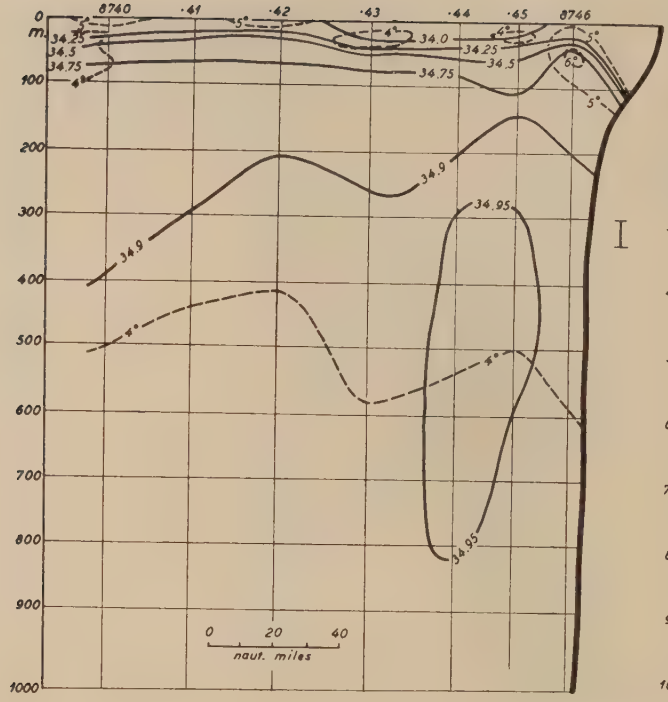


Figure 33. 7.—8. VII.

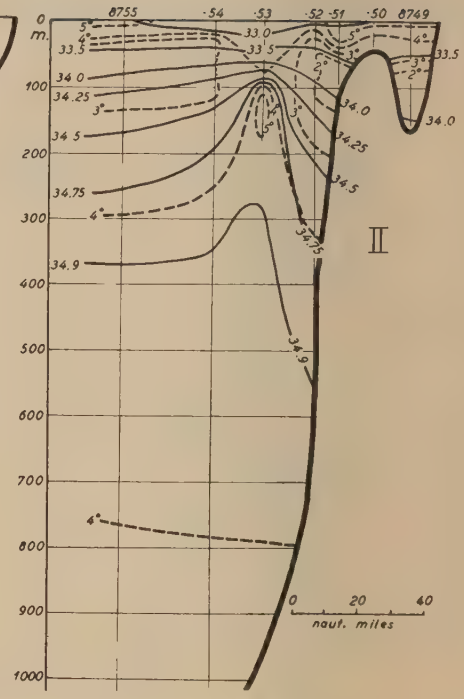


Figure 34. 15.—16. VII.

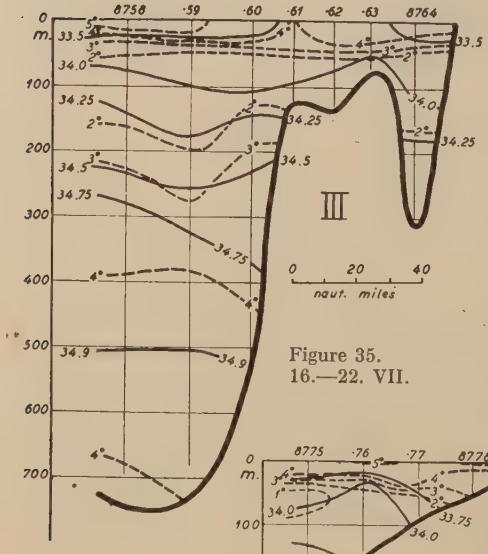


Figure 35.
16.—22. VII.

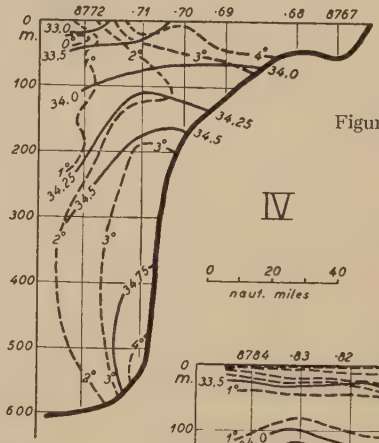


Figure 36. 23. VII.

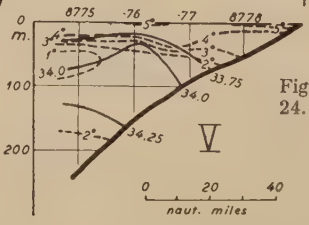


Figure 37.
24. VII.

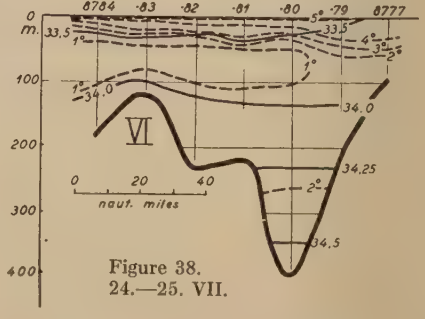


Figure 38.
24.—25. VII.

Figures 33—38. Vertical sections I to VI, July 1954. (Location shown in Figure 31.)

Plankton.

Investigations from Scottish Research Vessels in 1953.

Plankton samples were obtained during crossings of the Faroe Channel made in February, May, June, and August, and on the Faroe plateau in February, April, May, and June. A series of stations was worked due north of Faroe to about 64° N. in May, and in June samples were taken between Faroe and the south-east coast of Iceland, along the south coast, in Faxa Bay and from Reykjanes to Rockall and the Butt of Lewis. The area between Rockall and the west Scottish coast was also investigated in August.

One of the features of the year was the abundance of the siphonophore *Galetta biloba* (= *G. australis*). This species was reported in Vol. No. 9, p. 118, as being common with *Hippopodius* and *Chelophyes* in the Shetland area during 1952. These species survived the winter and a new invasion from the west, early in 1953, with *Galetta* dominating, flooded a very large area including east Shetland, the whole of the southern half of the Faroe-Shetland Channel and the area between Faroe Bank and the Butt of Lewis, but excluding the northern side of the Faroe Channel, Faroe plateau and the area to the north of Faroe. In the area occupied by *Galetta* and other oceanic species the crustaceous element was very sparse indeed, but to the north and north-east *Calanus finmarchicus* was extremely abundant.

By the summer it was realized that the oceanic fauna was much more widespread and that it contained a much greater proportion of southern species than in recent years. Indeed, the distribution of "Lusitanian" species extended well to the west of Rockall and to about 61° N. on the line between Reykjanes and Rockall while there was an unusual penetration to the north via the west of Faroe to about 63°N. It is not surprising that this influx brought with it not only a great variety of the commoner oceanic species but also many not usually found in this area, and the fauna contained indications that a Mediterranean admixture reached well into the Faroe Channel. Of particular interest amongst these rarer forms are the Thaliacea *Cyclosalpa virgula*, hitherto unrecorded from the north temperate Atlantic, which was found both east and west of Rockall. *Ihlea* (*Salpa*) *asymmetrica*, usually found in a very disintegrating condition was, in 1953, found thriving and penetrated well into the northern North Sea with the more tolerant species *Iasis zonaria* and *Salpa fusiformis* (see also the Atlantic Slope Report). Other uncommon species, such as *Sagitta hexaptera*, *Vibilia pyripes* and the polychaetes *Lopadorhynchus uncinatus* and *Harmathoë benthophila*, occurred to the north-west of Rockall. Large numbers of siphonophores including *Vogtia spinosa*, *Bassia bassensis*, *Eudoxoides spiralis*, *Rosacea plicata*, *Praya cymbiformis* and oceanic medusae such as *Rhopalonema velatum*, *Nausithoë punctata* and *Atolla bairdii*, all penetrated the Faroe Channel at least as far as Shetland. Larvae of oceanic fish such as *Fierasfer* spp. and *Nansenia groenlandica* were found north-west of Orkney in June.

The signifiance of this abundance and penetration of exotic species in 1953 is further reported in the North Sea Report, and will be more fully discussed in a separate paper.

Plankton to the north and north-east of Faroe, and on the northern half of the Faroe-Shetland Channel, contained boreal plankton. A continuation of this fauna was sampled in deep water, below the oceanic fauna, between Faroe Bank and the Wyville Thomson Ridge, but was less in evidence than usual in the deep water on both sides of Rockall. The areas of plankton richest in protein were found in May to the immediate south-east of Faroe, and between Faroe Bank and Faroe; and in June between Faroe and Iceland and in areas near the south coast of Iceland, notably off Reykjanes, Portland, and Ingolfshöfdi.

J. H. Fraser.

THE FISH

Eggs and Larvae. **Faroes.**

Scottish Haddock Investigations.

In 1953 Scottish research vessels again sampled a close grid of stations in Faroese waters, primarily to investigate the planktonic stages of the haddock. Unfortunately, of the scheduled surveys, only two (6.—15. April and 13.—20. June) were carried out.

The spawning season of the haddock in 1953 as deduced from the size of the largest larvae taken in April and of the smallest taken in June, extended from 1. March to 8. May. This is in close agreement with the dates derived from previous year's data. From a comparison of the density of larvae on the two cruises in 1953 with similar ones in 1952, it appears that spawning activity followed a similar course in the two years, reaching peak intensity in early April. Any figure for total spawning intensity for the 1953 season, based on only one cruise during the period of active spawning, can be merely tentative—all the evidence however points to a value only slightly less than that attained in 1952.

In April three centres of spawning activity were evident:—(i) over the Nolsø-Fuglø Bank area, (ii) to the north of the islands towards the edge of the shelf, at depths of over 70 fathoms, (iii) a more diffuse region to the west of Kolter and Suderø. Haddock larvae in April were widespread in small numbers on both the east and west sides of the plateau but were not taken to the north or south of the islands; the greatest density of these occurred over Nolsø and Sandø Banks. By June larvae were taken everywhere around the islands except on the east side north of Sandø. The greatest densities of larvae in this month occurred to the east of Suderø and west of Myling.

A growth coefficient based on only two cruises would be open to grave suspicion if it had to stand alone; that calculated from the 1953 data, (an increase in the logarithm of the length of 0.012 per day) is in sufficient accord with coefficients derived from previous data to engender more confidence in it. Mortality estimates are also unreliable owing to lack of data. The figures arrived at are a mean daily mortality of 7% between the two cruises for eggs spawned during the first cruise, and of 4% per day during this period for eggs spawned previous to the first cruise. These figures are comparable with the 1952 ones and would suggest that the 1953 haddock brood at Faroe will be a "moderate-good" one. This conclusion is supported by the frequency of haddock larvae in June, which, from Scottish records, has so far provided a fairly reliable index of haddock brood prospects at Faroe. Above a size of 7 mm. the numbers of haddock larvae per haul were almost identical with the 1952 figures. Below this size, larvae were considerably fewer in 1953, but once mortality has taken its inevitable toll these would add little in either year to the total figure of benthonic fish. Thus both lines of approach suggest that the 1953 haddock brood at Faroe will be only slightly inferior to that of 1952.

ALAN SAVILLE.

Haddock.

Survey of the Faroe Population.

Further surveys of the haddock population at Faroe have been made by F. R. S. "Scotia" during 1953, along the lines first adopted in 1950.

Age composition[1]).

The age composition of haddock sampled by "Scotia" and from commercial trawlers on the Aberdeen fish market is shown in Tables 2 and 3A respectively. The size composition of the commercial landings is shown in Table 3B. By converting these mean lengths to weight (using data from RUSSELL, 1914[2]) and then multiplying each by the appropriate number per 10 hours fishing (Table 3A), estimates of

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[1]) There is a correction to be made to Table 5 of the haddock contribution for 1950 (Ann. Biol. **7**, (1950, 1951, p. 28)). In that table, the age composition is incorrectly given as "per 10 hours' fishing", whereas it should have read "per hour's fishing". For comparison with the corresponding tables of $\frac{\text{other}}{\text{subsequent}}$ years, the results should be multiplied by 10.

[2]) RUSSELL (1914), Bd. Agric. and Fish. Inv., Ser. II, Sea Fish, **1**, pt. I.

Table 3. Aberdeen Trawlers' Market Samples - Faroe Haddock - 1953.

A. Number landed/10 hrs. Fishing.

Brood	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1952.....	—	—	—	—	1.68	—	—	—	92.69	193.3	288.40	488.58
1951.....	153.15	20.41	46.63	17.17	60.55	453.45	924.51	1207.19	719.43	737.3	554.64	630.74
1950.....	308.00	208.71	196.18	253.33	228.44	512.31	522.15	340.01	316.28	185.8	90.17	101.58
1949.....	115.92	161.09	262.00	316.42	421.25	154.23	153.21	121.87	145.67	77.0	49.18	42.21
1948.....	25.73	70.02	113.31	113.21	124.49	54.97	67.13	58.98	62.63	38.3	18.88	29.66
1947.....	3.37	13.35	8.69	15.32	5.65	7.27	14.89	13.53	10.44	4.00	1.27	5.85
1946.....	1.04	1.63	2.98	1.83	16.96	4.04	1.72	4.63	4.49	0.96	2.49	—
1945.....	1.28	16.28	8.05	10.45	22.61	4.87	26.81	17.32	21.21	10.84	5.27	9.10
1944.....	4.59	8.78	9.98	9.14	7.54	7.87	42.66	15.65	14.98	5.12	5.33	13.60
1943.....	1.04	7.87	1.97	7.15	—	1.00	5.69	1.36	4.03	—	0.80	10.55
1942.....	0.21	—	0.50	0.36	—	—	0.50	0.30	1.42	—	—	—
1941+....	0.21	—	0.52	3.14	—	0.10	2.07	—	—	0.14	—	—

B. Mean Lengths of each Age-Group sampled.

1952.....	—	—	—	—	29.00	—	—	—	25.62	31.47	32.83	31.56
1951.....	31.73	31.98	31.76	32.97	32.25	34.55	35.12	35.67	35.53	37.74	39.78	38.30
1950.....	39.62	39.64	39.89	39.02	39.45	39.93	42.79	42.78	43.10	46.48	48.82	46.51
1949.....	47.65	47.53	48.43	45.52	46.91	47.15	50.41	51.33	50.54	51.68	53.53	54.56
1948.....	52.04	55.25	53.62	51.15	53.03	55.39	56.55	57.47	54.80	56.92	58.72	58.47
1947.....	56.78	59.00	61.87	58.89	62.00	60.18	62.03	61.69	55.20	59.54	65.33	64.00
1946.....	59.80	66.00	64.37	62.00	64.22	64.91	57.00	64.78	62.50	63.75	64.79	—
1945.....	63.98	61.99	64.45	62.02	66.67	67.22	65.66	66.58	64.55	65.56	65.19	66.60
1944.....	64.59	65.38	66.56	67.87	68.25	68.08	66.62	69.15	66.59	66.33	69.02	70.35
1943.....	69.72	66.80	66.40	70.32	—	72.33	69.64	71.83	70.17	—	69.67	69.53
1942.....	69.00	—	74.25	74.50	—	—	69.00	69.00	66.50	—	—	—
1941.....	71.00	—	—	81.66	—	80.00	73.67	—	—	72.00	—	—

C. Estimated Weights[1]) landed/10 hrs. Fishing (in cwt.).

1952.....	—	—	—	—	0.01	—	—	—	0.25	1.00	1.71	2.48
1951.....	0.78	0.11	0.30	0.10	0.32	3.03	6.59	9.15	5.35	5.99	5.99	5.86
1950.....	3.20	2.17	1.91	2.36	2.44	5.40	6.41	4.52	4.26	3.14	1.81	1.71
1949.....	2.12	2.91	4.49	4.63	6.93	3.12	3.32	2.87	2.92	1.83	1.34	1.25
1948.....	0.63	2.09	2.66	2.39	2.96	1.61	2.09	1.96	1.82	1.24	0.68	1.06
1947.....	0.11	0.49	0.34	0.51	0.22	0.27	0.61	0.55	0.27	0.15	0.06	0.28
1946.....	0.04	0.08	0.12	0.07	0.72	0.20	0.06	0.22	0.19	0.04	0.12	—
1945.....	0.06	0.67	0.33	0.38	1.07	0.25	1.29	0.89	0.97	0.53	0.24	0.45
1944.....	0.22	0.43	0.44	0.45	0.37	0.46	2.06	0.89	0.73	0.26	0.32	0.80
1943.....	0.06	0.40	0.09	0.43	—	0.06	0.32	0.08	0.21	—	0.05	0.62
1942.....	0.01	—	0.03	0.02	—	—	0.03	0.02	0.07	—	—	—
1941+...	0.01	—	0.04	0.21	—	0.01	0.12	—	—	0.01	—	—
Total.....	7.24	9.35	10.75	11.55	15.04	14.41	22.90	21.15	17.04	14.19	12.32	14.51
Actual landings per 10 hours by Aberdeen trawlers...	6.82	9.18	10.65	11.17	14.11	12.31	20.67	19.15	16.94	13.95	12.47	11.87

[1]) Estimated using data from RUSSELL, 1914.

Table 2. Age Composition of Haddock caught by F.R.S. "Scotia" at Faroe - 1953.

(Excluding Faroe Bank).
Numbers per 10 hours fishing.

Year-class	Feb.	March	April	May	June	August	Nov.
1953	—	—	—	—	1.0	8700.0	495.0
1952	111.7	390.0	830.0	341.7	247.8	6140.0	2510.0
1951	247.5	140.0	398.3	83.3	241.1	350.0	1440.0
1950	36.7	5.0	28.3	33.3	67.9	40.0	220.0
1949	20.0	—	3.3	8.3	7.8	20.0	45.0
1948	9.2	—	—	5.0	11.1	20.0	15.0
1947 & over	1.7	—	—	3.3	6.7	—	15.0
No. of Hours	12	2	6	6	9	1	2

the weights of each brood landed per 10 hours fishing have been made (Table 3C).

The commercial landings were composed of haddock of one to twelve years of age. As before, age-groups II—V (spawned in 1948—1951) made up the greater proportion of the landings, although the 1944 and 1945 broods were by no means insignificant.

The 1953 brood was sampled by "Scotia" in June, August, and November. The average number caught/10 hours in each month varied so greatly, however, (Table 2) that it is not yet possible to determine the strength of this brood.

Table 4. Mean Lengths and Standard Errors (S. E.) of

Year-Class	Age	Month	North-West			North			North-East			East		
			Mean	S. E.	No. of Fish	Mean	S. E.	No. of Fish	Mean	S. E.	No. of Fish	Mean	S. E.	No. of Fish
1953	0+	June	—	—	—	—	—	—	—	—	—	—	—	—
	0+	August	—	—	—	—	—	—	—	—	—	9.8	0.036	870
	0+	Nov.	—	—	—	—	—	—	—	—	—	15.1	0.194	99
1952	0+	Feb.	19.9	0.513	11	17.5	0.236	56	14.5	0.608	11	15.3	0.241	33
	0+	March	—	—	—	—	—	—	—	—	—	15.8	0.176	78
	1+	April	—	—	—	18.7	0.144	220	—	—	—	14.9	0.136	144
	1+	May	17.8	0.283	52	—	—	—	—	—	—	16.4	0.141	134
	1+	June	19.5	0.373	34	—	—	—	17.1	0.223	73	17.3	0.255	68
	1+	August	—	—	—	—	—	—	—	—	—	21.2	0.064	614
	1+	Nov.	—	—	—	—	—	—	—	—	—	26.6	0.096	502
1951	1+	Feb.	29.5	2.754	4	28.3	0.162	112	29.3	0.342	3	27.2	0.182	162
	1+	March	—	—	—	—	—	—	—	—	—	27.5	0.306	28
	2+	April	30.0	3.000	2	30.1	0.191	157	—	—	—	26.1	0.394	27
	2+	May	33.2	0.704	20	—	—	—	29.7	2.187	3	29.4	0.521	17
	2+	June	33.2	0.364	85	—	—	—	27.6	0.495	29	31.5	1.025	6
	2+	August	—	—	—	—	—	—	—	—	—	32.2	0.402	35
	2+	Nov.	—	—	—	—	—	—	—	—	—	37.4	0.171	288
1950	2+	Feb.	43.4	1.055	12	36.0	—	1	35.7	0.885	3	36.7	0.579	24
	2+	March	—	—	—	—	—	—	—	—	—	34.0	—	1
	3+	April	—	—	—	38.0	0.894	5	—	—	—	35.3	2.262	3
	3+	May	40.1	1.060	8	—	—	—	36.2	1.194	6	—	—	—
	3+	June	42.9	0.718	28	—	—	—	37.9	1.806	9	—	—	—
	3+	August	—	—	—	—	—	—	—	—	—	41.2	0.483	4
	3+	Nov.	—	—	—	—	—	—	—	—	—	46.4	0.526	44
1949	3+	Feb.	50.0	1.732	3	—	—	—	42.5	1.500	2	44.5	0.950	15
	3+	March	—	—	—	—	—	—	—	—	—	—	—	—
	4+	April	49.0	—	1	—	—	—	—	—	—	37.0	—	1
	4+	May	49.0	3.000	2	—	—	—	42.0	—	1	—	—	—
	4+	June	46.3	1.857	3	—	—	—	52.0	—	1	—	—	—
	4+	August	—	—	—	—	—	—	—	—	—	43.0	2.000	2
	4+	Nov.	—	—	—	—	—	—	—	—	—	49.0	1.518	9
1948	4+	Feb.	56.6	0.980	5	—	—	—	50.0	3.000	2	51.0	—	1
	4+	March	—	—	—	—	—	—	—	—	—	—	—	—
	5+	April	—	—	—	—	—	—	—	—	—	—	—	—
	5+	May	54.3	2.335	3	—	—	—	—	—	—	—	—	—
	5+	June	56.7	1.542	6	—	—	—	—	—	—	57.0	—	1
	5+	August	—	—	—	—	—	—	—	—	—	53.0	1.000	2
	5+	Nov.	—	—	—	—	—	—	—	—	—	52.3	1.204	3

Size composition.

The mean lengths and standard errors of each brood sampled by "Scotia" during each month are shown in Table 4. As in previous years, the largest fish on the plateau were located in the north-west area, whilst the smallest were in the east, and in particular on Sandø Bank.

Mortality estimates.

Estimates of the mortality rates of all broods over the period 1950—1953 have now been made. Statistical tests show that there is no significance in the differences between the estimates for different broods, although there are differences between the 1950—1951 estimates and those made for 1951—1952 and 1952—1953.

Mean estimates and their 95% confidence limits were:—

Period 1950—1951 73 % with limit 78 % and 67 %
" 1951—1952 and 1952—1953 } 49 % " " 55 % and 43 %

These estimates differ somewhat from those given in previous issues of the Annales owing to the fact that the statistical methods then used were found to be subject to some bias. A separate report is now in the course of preparation, in which these and similar problems concerning unbiased estimates are discussed.

Haddock of each Age-Group from Faroe - 1953.

			West			South			Sandø Bank			Faroe Bank		
			Mean	S. E.	No. of Fish	Mean	S. E.	No. of Fish	Mean	S. E.	No. of Fish	Mean	S. E.	No. of Fish
1953	0+	June	—	—	—	6.0	—	1	—	—	—	—	—	—
		August	—	—	—	—	—	—	—	—	—	14.3	0.075	336
		Nov.	—	—	—	—	—	—	—	—	—	—	—	—
1952	0+	Feb.	16.0	0.577	3	—	—	—	14.6	0.432	20	—	—	—
	0+	March	—	—	—	—	—	—	—	—	—	—	—	—
	1+	April	15.8	0.137	134	—	—	—	—	—	—	—	—	—
	1+	May	15.5	0.384	17	15.0	—	2	—	—	—	—	—	—
	1+	June	18.0	1.528	3	18.7	0.329	45	—	—	—	—	—	—
	1+	August	—	—	—	—	—	—	—	—	—	22.5	0.073	367
	1+	Nov.	—	—	—	—	—	—	—	—	—	—	—	—
1951	1+	Feb.	27.5	0.992	6	—	—	—	22.7	0.335	10	—	—	—
	1+	March				—	—	—	—	—	—	—	—	—
	2+	April	27.8	0.246	53	—	—	—	—	—	—	—	—	—
	2+	May	33.7	2.849	3	30.9	1.317	7	—	—	—	—	—	—
	2+	June	31.1	0.764	19	30.8	0.311	78	—	—	—	—	—	—
	2+	August	—	—	—	—	—	—	—	—	—	33.5	0.347	68
	2+	Nov.	—	—	—	—	—	—	—	—	—	—	—	—
1950	2+	Feb.	34.0	—	1	—	—	—	30.3	0.885	3	—	—	—
	2+	March	—	—	—	—	—	—	—	—	—	—	—	—
	3+	April	36.1	0.920	9	—	—	—	—	—	—	—	—	—
	3+	May	45.0	—	1	42.4	1.400	5	—	—	—	—	—	—
	3+	June	36.0	2.273	4	42.8	0.926	20	—	—	—	—	—	—
	3+	August	—	—	—	—	—	—	—	—	—	47.4	0.783	25
	3+	Nov.	—	—	—	—	—	—	—	—	—	—	—	—
1949	3+	Feb.	45.0	—	2	—	—	—	40.0	1.000	2	—	—	—
	3+	March	—	—	—	—	—	—	—	—	—	—	—	—
	4+	April	—	—	—	—	—	—	—	—	—	—	—	—
	4+	May	47.0	—	1	49.0	—	1	—	—	—	—	—	—
	4+	June	47.0	—	1	48.0	—	2	—	—	—	—	—	—
	4+	August	—	—	—	—	—	—	—	—	—	62.0	1.155	3
	4+	Nov.	—	—	—	—	—	—	—	—	—	—	—	—
1948	4+	Feb.	59.3	2.729	3	—	—	—	—	—	—	—	—	—
	4+	March	—	—	—	—	—	—	—	—	—	—	—	—
	5+	April	—	—	—	—	—	—	—	—	—	—	—	—
	5+	May	—	—	—	—	—	—	—	—	—	—	—	—
	5+	June	53.5	2.500	2	55.0	—	1	—	—	—	—	—	—
	5+	August	—	—	—	—	—	—	—	—	—	—	—	—
	5+	Nov.	—	—	—	—	—	—	—	—	—	—	—	—

Table 5. Landings of three Size Categories by Aberdeen Trawlers from Faroe - 1953.

Cwt. per 100 Hours. XL = Extra Large L = Large.

Month	Hrs. Fishing	XL & L	Medium	Small	Total
January	4461	26.9	19.5	21.8	68.2
February	4632	60.2	20.9	17.3	98.3
March	9152	70.1	25.5	12.1	107.7
April	8036	61.0	28.9	24.2	114.1
May	4098	65.7	38.9	39.3	144.0
June	10657	43.4	31.6	49.4	124.4
July	11415	91.7	44.8	71.2	207.7
August	7974	84.9	39.5	60.7	185.2
September	4204	66.8	35.8	67.4	170.0
October	5261	47.4	31.6	66.5	145.6
November	5140	40.9	30.9	53.2	125.0
December	3797	33.5	30.6	53.6	117.7
Total (Mean)	78827	(61.6	32.5	45.4	139.5)

The commercial fishery.

The average weight of haddock caught per 100 hours fishing and landed by Aberdeen trawlers from Faroe during 1953 is shown in Table 5.

The average of 139.5 cwt. per 100 hours fishing for the year compares favourably with the corresponding data for 1951 and 1952 (124.8 and 125.7 cwt. respectively). This change was principally associated with an increase in the catch/unit of small haddock, the catch/unit of large haddock being much the same as in previous years.

R. Jones and W. Main.

Lemon Sole.

Landings of lemon soles from Faroese grounds by Aberdeen trawlers amounted to 8,054 cwt. in 1953. This total is 4,964 cwt. less than the quantity landed in 1952. In obtaining this catch more than a hundred fewer fishing trips were made and the total hours' fishing fell from 90,705 in 1952 to 78,903 in 1953. This represents a decline of 13% in the fishing effort. In dealing with the 1952 catch it was revealed that the fishing effort in that year showed a similar decline from that of 1951. In the last two years therefore the Scottish trawling effort at Faroe has declined by about 25%. In the same period the English trawling effort there declined by about 28%.

Other things being the same a reduction in the trawling effort of this magnitude might have been expected to reduce if not halt any decline in the catch per unit of fishing time in due course, or even to bring about some degree of recovery. For all that, the average catch per unit of fishing time in 1953 continued to fall, however, as the following figures for the last three years show:—

Aberdeen Trawlers - Catch per 100 hours' fishing in cwt.

Year	Large	Medium	Small	Total
1951....	4.4	6.9	3.7	15.0
1952....	3.6	7.0	3.7	14.4
1953....	2.7	5.0	2.5	10.2

Even more striking is the extent of the decline, namely, 4.2 cwt., which is shared by all three trade categories and is not due to any seasonal difference in the fishing from one year to another. In seeking for an explanation in the age composition of the lemon sole stock, it is unfortunate that trawling by the Scottish research vessel "Scotia" has been on a much reduced scale in 1953. Throughout the year from February to November only 36 one-hour trawl hauls were made in Faroese waters. The total catch of 94 lemon soles gives an average of 2.6 fish per hour as compared with 4.4 in 1952. The age analysis of the 1954 catch is as follows:—

Brood	1950	1949	1948	1947	1946	1945	1944	1943
Numbers	8	3	17	14	26	7	3	5
%	8.5	3.2	18.1	14.9	27.7	7.4	3.2	5.3

Brood	1942	1941	1940	1939	1938	1937	1936
Numbers	2	3	3	2	—	—	1
%	2.1	3.2	3.2	2.1	—	—	1.1

Thirteen broods from 1950—1936 are represented. For the fourth year in succession the 1946 brood (group VII) provides the highest number of fish from any single brood. This year-class has proved a strong one in the Faroe area but having regard to the heavy fishing since the war it is exceptional to find it still providing such a high proportion of the commercial stock. Next in order of importance come the 1948 and 1947 broods, neither of which can be regarded as providing better than moderate numbers of fish to the stock. While older broods from 1945—1936 continue to provide diminishing numbers of fish, a more regrettable feature of the year's age analysis is the poor recruitment of the younger broods of 1949 and 1950. The former definitely appears to have been a failure while the numbers of the 1950 brood, as yet not altogether within the commercially fishable size range, suggest only a slightly better survival.

The lemon sole stocks at Faroe now appear to be severely depleted and the lightening of the fishing intensity in the last two years has failed to produce an improvement in the average catch per unit of fishing time, largely because of poor recruitment since 1946.

BENNET B. RAE.

Cod. **Iceland.**

The Spawning Stock in 1953.

Table 6 shows the main characteristics of the spawning stock in 1953. The table is calculated in 10,000 and is based upon the age determinations of 4554 mature cod caught on long lines off the south and south-west coast of Iceland during the months January—May. All comparisons are made with the averages for the years 1930—1952.

There is a clear dominance of the 1945 year-class, as predicted in 1952. The percentage is slightly higher than expected. This is mainly caused by somewhat higher numbers than expected of recruit spawners which are nine years old. This year-class is expected to be dominant in the fishery in 1954 and comprise 34%.

The 1942 year-class has now been reduced to ca. 13% from 33% the year before. In 1954 it is expected to form only 6% of the total and after that year it will be of no importance in the commercial fishery. As a whole, there

Table 6. The Composition of the Spawning Stock of Cod in 1953.

	Age at first spawning											
Age-Group	3	4	5	6	7	8	9	10	11	12	13	Total
III.....	11	—	—	—	—	—	—	—	—	—	—	11
IV.....	—	222	—	—	—	—	—	—	—	—	—	222
V.....	—	9	266	—	—	—	—	—	—	—	—	275
VI.....	—	2	57	459	—	—	—	—	—	—	—	518
VII.....	—	—	9	119	459	—	—	—	—	—	—	587
VIII.....	—	—	—	31	430	2964	—	—	—	—	—	3425
IX.....	—	—	—	2	88	602	1030	—	—	—	—	1722
X.....	—	—	—	—	29	178	637	646	—	—	—	1490
XI.....	—	—	—	—	68	316	433	393	154	—	—	1364
XII.....	—	—	—	—	7	13	42	15	18	—	—	95
XIII.....	—	—	—	—	—	4	9	13	4	—	—	30
XIV.....	—	—	—	2	2	7	7	24	13	—	—	55
XV.....	—	—	—	—	4	9	26	20	13	—	—	72
XVI.....	—	—	—	—	2	—	4	9	7	—	—	22
XVII.....	—	—	—	—	7	13	26	11	26	11	2	96
XVIII....	—	—	—	—	—	—	2	9	4	—	—	15
XIX.....	—	—	—	—	2	—	—	—	—	—	—	2
Total No..	11	233	332	613	1098	4106	2216	1140	239	11	2	10001

	Spawning classes											
	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
No.....	6211	2265	760	415	129	56	68	30	41	17	7	—	2	10001

is a very remarkable lack of fish older than 11 years, only 4%, compared with the average of 25%.

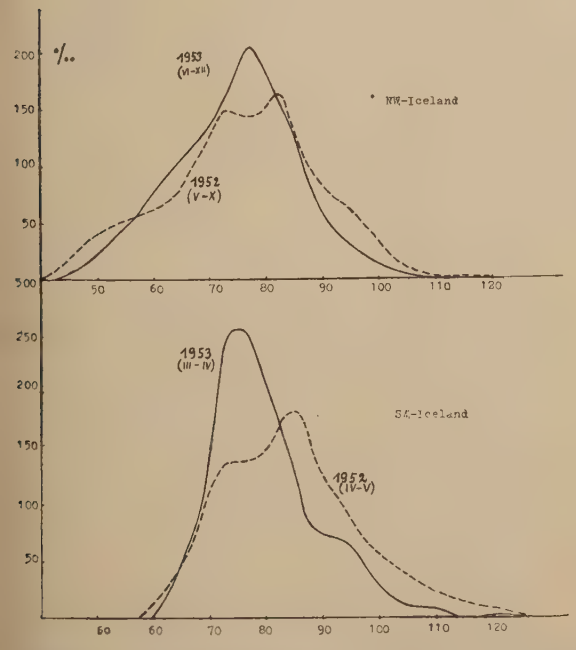

Figure 39. Length composition of German cod landings from NW. and SW. Iceland in 1952 and 1953.

There has been a gradual decrease in the average age since 1949. In that year the average age was 11.34 years, but in 1953 it was only 8.57 years. This means a reduction of 2.77 years or 24%.

The 1949 year-class is a promising one. In 1953 it constituted 2.2% of the total, compared with the average of 0.2%. In 1954 it is expected to give 9.7% compared with the average of 0.7%. This year-class has been found in quantity as immature fish around the coast.

Jón Jónsson.

German Observations.

Nearly all cod caught by German trawlers came from the north-western (May—December) and the south-western (February—April) Iceland. In 1953 the landings of Icelandic redfish increased to 55.2% of a total of 214,000 tons, and in addition the catches of cod continued increasing slowly from 18.6 to 19.9% (42,500 tons). In the NW. as well as in the SW. the 1953 catch of cod showed a small decrease in average length. According to the first age determinations the 1945 year-class seems to be predominant.

Arno Meyer.

Haddock.

Survey of the Haddock Stock in Faxa Bay in 1953.

In the last volume of *Annales Biologiques* a short survey was given of the haddock in the Faxa Bay during the summer of 1952, a few months after the bay had been closed to trawling and seine-netting (Ann. Biol. **9**, p. 43). It appeared that a single year-class, the 3-year-old fish comprised the major part of the hand-line catches (89.5%).

In 1953 trawling experiments in the Faxa Bay were started in order to find out the density of different species of fish in the Bay, especially haddock, plaice, halibut and lemon sole. At the same time marking experiments on haddock (376 fish marked), plaice (2047) and lemon sole (425) were carried out.

The trawl hauls were made by the research vessel "Maria Julia", using otter-trawl of about 60′, with the Vigneron-Dahl gear, during May, August and November. They were carried out on the two "traditional" stations in the southern part of the bay, inside (64°04′ N. 22°35′ W.) and outside (64°08′ N. 22°23′ W.) the old three miles limit (see Rapp. et Proc.-Verb., **120**, p. 92). The experiments are intended to be continued quarterly in the years to come, in addition with hydrographic, plankton, and bottom observations.

As the trawling experiments will be continued, and the main results will probably be dealt with annually in this series, it might be of interest, for later comparison, to survey the composition of the catches as they appeared in 1953. This is done in Table 7, where the average number of each species per trawling hour is given. It is evident that in 1953 the haddock was more numerous in the Bay than any other species.

Table 7. Faxa Bay 1953.

Number of fish per trawling hour.

Species	Inner Bay May	Inner Bay Aug.	Inner Bay Nov.	Outer Bay May	Outer Bay Aug.	Outer Bay Nov.
Gadus callarias.	22.6	11.8	84.0	8.9	1.9	44.3
" *virens...*	+	0.7	—	—	—	—
" *aeglefinus*	970.0	1059.1	817.2	1341.0	764.8	579.8
" *merlangus*	—	23.1	—	—	34.3	—
Pleuron. platessa	49.0	103.7	10.5	109.0	243.7	31.6
" *microceph.*	22.7	22.6	5.0	1.0	8.1	0.2
" *limanda*	116.2	325.1	53.7	45.0	185.0	331.9
Hippogl. vulgaris	4.0	6.8	4.7	7.0	8.5	4.4
Drepanopsetta .	3.4	—	1.7	6.0	2.4	0.3
Anarrh. lupus..	5.4	1.9	0.1	—	0.2	—
Cyclopt. lumpus	+	+	—	—	—	—
Lophius piscatorius	—	+	—	—	+	—
Raja radiata...	+	—	4.3	+	—	9.2

In Table 8 the length-distribution of the haddock is shown by months for each of the two stations separately. 27,741 fish were measured altogether, 11,809 on the inner and 15,932 on the outer station. It is clearly seen that the average length increases during the summer on both stations, the difference from May to November being 9.63 cm. on the inner and 7.71 cm. on the outer locality, roughly corresponding to a years growth. The increase is less on the outer station which agrees with the fact that the fish here are on the whole larger and older.

Table 8. Length Composition of Haddock in Faxa Bay, 1953 (‰).

cm.	Territorial station May	Territorial station August	Territorial station Nov.	Ex-territorial station May	Ex-territorial station August	Ex-territorial station Nov.
90—94....	—	—	+	—	—	—
85—89....	—	—	1	—	+	+
80—84....	—	1	1	—	+	—
75—79....	—	2	1	—	1	1
70—74....	—	2	2	—	+	+
65—69....	—	6	7	1	6	13
60—64....	2	36	30	5	32	59
55—59....	4	88	88	25	100	151
50—54....	11	121	187	65	160	201
45—49....	37	136	231	110	156	181
40—44....	129	156	210	205	183	188
35—39....	388	198	143	321	175	118
30—34....	359	158	86	221	129	71
25—29....	67	96	13	45	57	17
20—24....	3	—	+	2	1	+
S.....	1000	1000	1000	1000	1000	1000
N.....	1276	3653	6880	2558	7576	5798
M.....	35.82	42.31	45.51	39.26	43.69	46.97

The difference in length is seen clearly in Figure 40. There are relatively more large and less small haddock on the outer station in every month investigated. The curves for August and November representing the outer station show two peaks, which correspond with the presence of 3- and 4-year-old fish, but there is generally too much overlapping to distinguish these two age-groups by size alone.

In Table 9 the age composition is shown by months and localities. Nine age-groups occurred in the catches from 1 to 9 years of age, belonging to the year-classes 1952, 1951, ... 1944. Only a part of the catches were used for age determination (2359 fish), but it is clear that the greater part of the stock, or 71.3 to 92.9% is composed of 3- and 4-year-old fish,

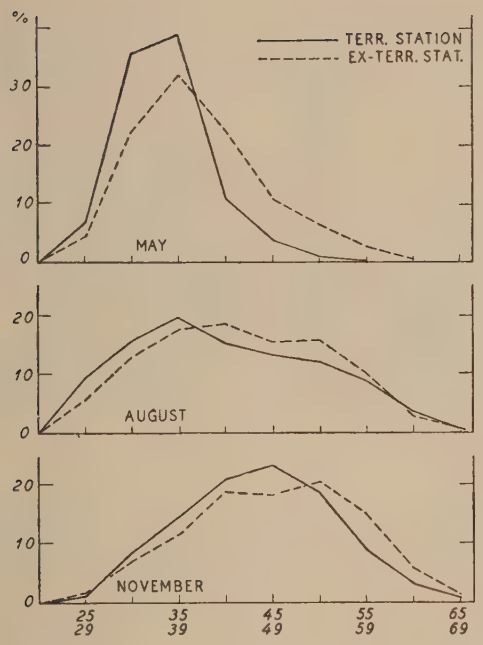

Figure 40. Length distribution of haddock, Faxa Bay, 1953.

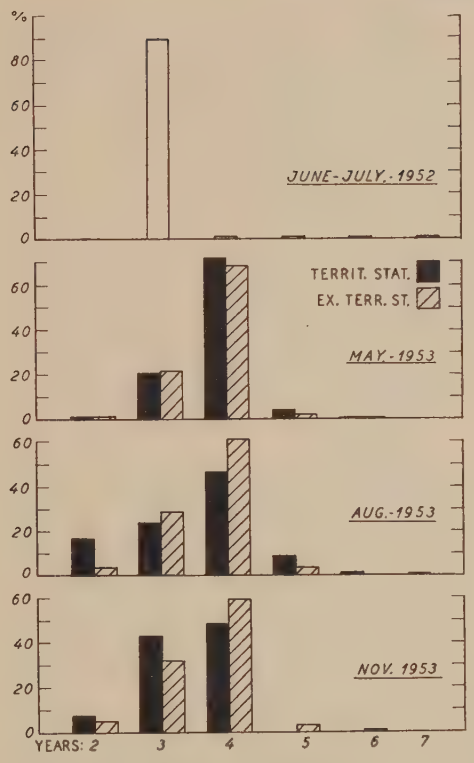

Figure 41. Age composition of haddock, Faxa Bay, 1953.

the 1950 and 1949 year-classes, the latter being the strongest.

On examination of Figure 41 three features appear: 1) the 1949 year-class which was largely predominant in 1952 is still an absolute dominant, but not to the same degree as in 1952, owing to 2) the occurrence of a new, strong year-class, consisting of 3-year-old fish (1950 brood); 3) a certain difference in the age composition on the two localities exists, first of all, the fish on the outer station are somewhat older than those on the inner one, as already mentioned. There is also a seasonal difference, which is particularly well pronounced in the 4-year-old fish. The trend seems to be that fish of this age move from the inner to the outer waters of the Bay towards autumn, probably due to the approaching maturity of part of this age-group.

Based on Table 10, where the average length of each particular year-class from month to month and from locality to locality is recorded, an attempt is made in Figure 42 to plot the growth.

For the 2- and 5-year-olds the material is rather too small for this purpose, and for the year-classes not included in the table (or in the Figure 42) it is far too small. The figure

Table 9. Age Composition of Haddock from Faxa Bay, 1953 (‰).

Years	Brood	Territorial Station May	Territorial Station August	Territorial Station Nov.	Ex-territorial Station May	Ex-territorial Station August	Ex-territorial Station Nov.
1	1952	—	—	2	—	—	—
2	1951	14	167	74	16	30	50
3	1950	211	243	429	223	288	321
4	1949	**718**	**470**	**491**	**686**	**610**	**597**
5	1948	38	85	4	22	36	26
6	1947	5	4	—	3	—	4
7	1946	—	6	—	0	—	2
8	1945	—	8	—	6	—	—
9	1944	—	—	—	6	—	—
?	?	14	17	—	38	36	—
S		1000	1000	1000	1000	1000	1000
N		209	480	480	318	362	510
M		41.45	46.54	43.27	43.60	40.50	49.50

Table 10. Average Length of 2—5-year-old Haddock in Faxa Bay, 1953.

Years	Territorial station May	Territorial station August	Territorial station November	Ex-territorial station May	Ex-territorial station August	Ex-territorial station November
2	29.00	29.96	31.20	29.20	29.35	32.72
3	35.28	47.38	39.19	35.52	41.29	43.21
4	42.75	53.25	48.67	45.37	50.68	52.63
5	51.86	59.44	57.00	51.29	58.89	58.85

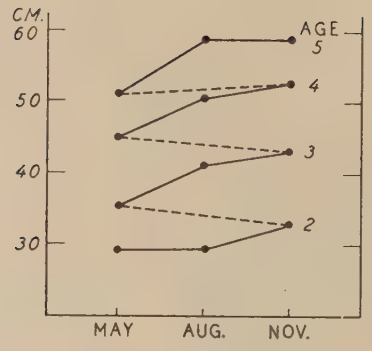

Figure 42. Growth rate of 2—5-year-old haddock from May to November 1953, at the innermost station of Faxa Bay.

comprises only the left hand part of the table, the stock on the innermost station. When considering Figure 42 it will be noted that the 2-year-old fish show practically no growth from May to August, in contrast to a relatively large increase in length later on. This can possibly be explained through the selectivity of the gear applied, which allows the smallest fish of the brood to pass through the meshes in spring, when the size is less than later on. As far as the other three year-classes are concerned, the growth is fast during the first part of the season, May—August, and relatively slow from August —November. For the 5-year-olds there is actually no increase from August to November, and the average size in this group in May is furthermore smaller than that of the 4-year-olds in August. If we assume that the largest individuals of the 5-group migrate from the Bay to deeper waters with approaching maturity—both features become easily explainable.

Having described the characters of the haddock stock in the Faxa Bay, in 1953, we may compare these results with the corresponding earlier findings.

Table 11. Survey of Trawling Experiments on the two Stations in Faxa Bay in May, August, and November.

Year	May	Aug.	Nov.	Year	May	Aug.	Nov.
1925	—	+	—	1937	+	—	—
1927	—	+	—	1939	+	—	—
1928	—	+	—	1940	—	—	+
1933	—	+	—	1945	+	—	+
1934	+	—	—	1953	+	+	+

In Table 11 a survey of all trawling experiments on our two stations in Faxa Bay, in May, August, and November is given. There is not a great amount of material available for comparison, especially in November, and in addition no less than 5 vessels have been engaged in the sampling (see Table 12), each with her own type of trawl. However, these drawbacks are at least partly compensated by the fact that the difference between then and now is extremely well marked with scarcely any exception. It should be remembered, in addition, that the otter-trawl operated by "Maria Julia" (about 60′) is smaller than that of any of the other vessels, except the one used by "Dana" (about 50′).

Let us first take a look at Table 12, where the number of haddock caught per trawling hour is recorded and specified as to locality, year and month.

Table 12. Haddock, Faxa Bay. Density of Stock on the Territorial and Ex-territorial Station in Faxa Bay.

Average length of fish etc. in 1953 and previous years.

Month	Year	Vessel	No per trawl. hour Inner	Outer	I/O %	Average length cm. Inner	Outer
May	1934	"Dana"	374	66	18	27.1	30.3
	1937	"Thor"	584	4	1	22.2	42.9
	1939	"Thor"	566	2	+	32.1	35.9
	1945	"Bragi"	282	19	7	35.1	52.1
	1953	"M. Julia"	970	1341	138	35.8	39.3
	Earlier average		451	23	5	29.1	40.3
August	1925	"Dana"	195	10	5	28.7	26.8
	1927	"Dana"	56	—	—	24.3	—
	1928	"Thor"	11	3	27	33.7	37.2
	1933	"Dana"	135	70	52	22.0	25.5
	1953	"M. Julia"	1059	765	72	42.3	43.7
	Earlier average		99	28	28	27.2	29.8
Nov.	1940	"Reykj."	840	45	5	44.4	30.0
	1945	"Bragi"	231	104	45	39.1	42.8
	1953	"M. Julia"	817	580	71	45.5	47.0
	Earlier average		535	75	14	41.8	36.4

The average numbers of fish for each month during previous years ("earlier average") have been calculated for comparison with the corresponding values in 1953. Furthermore the relative stock-density on the outermost station (O) has been calculated in percentages of the density on the innermost one (I). Finally the two last columns of the table show the average size of all haddock caught, specified as to locality, year and month.

Details of the table are given in the Figures 43—45. In Figure 43 the black columns indicate the number caught per trawling hour in

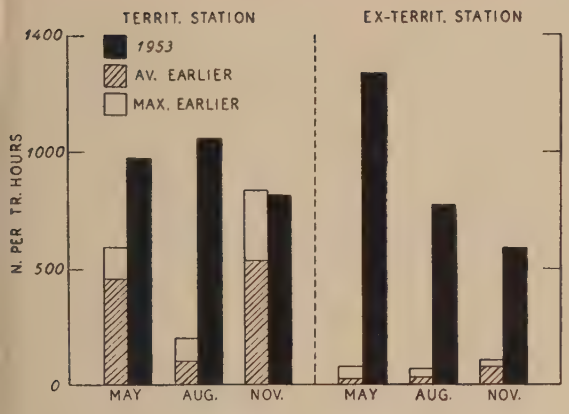

Figure 43. Number of haddock caught per trawling hour in Faxa Bay, 1953.

1953, and the hatched columns indicate the corresponding averages for the same months and localities in earlier years. The maximum yield for each month in an earlier year is also shown by means of white rectangles added to the hatched ones (the averages). The figure needs no further explanation. In 1953 the yield per-unit-of-effort is much higher, and on the outer locality many times higher, than the corresponding average of earlier years and also higher than the maximum of any preceding year, with one exception only—November on the territorial station. We must, however, keep in mind that we have only two previous records from November, one of which comes from the large steam trawler "Reykjaborg", which operated a trawl with 95′ head-line.

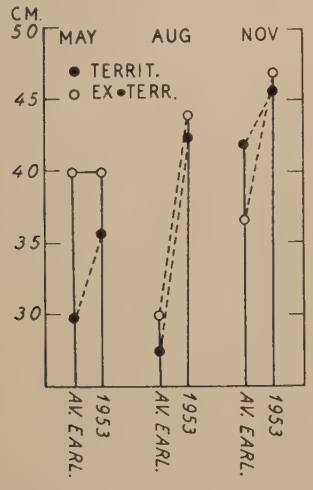

Figure 44. Average length of haddock in Faxa Bay in 1953 and earlier.

Turning to Figure 44 we will consider the average size of all haddock caught, grouped as before. As in previous years the fish outside the old territorial limit are found to be larger than those inside the limit. However, in addition, the fish in 1953 is much larger in every month and locality than previously. The only exception is found outside the old territorial limit in the month of May, at which time the length is about the same in 1953 as it was earlier. This is due to unusually large fish being taken in 1945 (average 52.1 cm., but only 19 fish per trawling hour against 1341 in 1953) and also in 1937 (42.9 cm., 4 fish). Further details may be seen in Table 12.

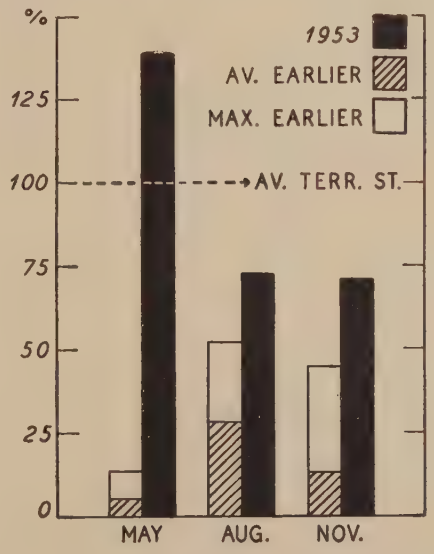

Figure 45. Density of haddock at the outermost station of Faxa Bay, in percentages of the density at the innermost station.

It is well known that the density of haddock in the territorial locality was several times higher than that outside the old territorial line in previous years. This is demonstrated in Table 12 (3rd column from the right), and shall be emphasized here. Also a great change seems to have taken place, as is explained by Figure 45. Within all months of 1953 the difference in density was found to be much less than in any earlier year. Actually, there were more fish on the outer locality than on the inner one in May (138%), the relation for August and November being 72 and 71% respectively (see Table 12). If similar results are obtained in future experiments it means

that an extensive area will comprise the nursery ground as opposed to the relatively narrow coastal waters earlier.

The comparisons between 1953 and earlier years of the haddock in Faxa Bay, described in the above, can be concluded as follows:— 1) the stock is much denser now than earlier, in some cases many times denser, 2) the fish is much larger than it used to be, and 3) the prevailing difference between the density of fish on the inner and outer station is about to be wiped out, the number of fish on the outer locality in some cases even surpassing that on the inner one.

An estimate of the increase in the stock by weight has been made in Table 13 for both localities in August.

Table 13. Haddock, Faxa Bay 1953.
Comparison with earlier Years of Stock-Density by Weight.

	Inner Bay		Outer Bay	
	1925, '27, '28, '33	1953	1925, '27, '28, '33	1953
No. per trawl. hour	99	1059	28	765
Av. length cm.	27.2	42.3	29.8	43.7
Av. weight gr.	200	800	240	880
Total weight, kg.	ca. 20	ca. 850	ca. 7	ca. 675
Ratio	1	42.5	1	96.5

Through the investigations two sets of information are available: the number of fish per trawling hour earlier and now, and the mean lengths. If we estimate the mean weights, corresponding to the mean lengths, as done in the table (Sæmundsson 1925), it is easy to calculate the total weight of fish obtained per trawling hour. If we now put the total weight obtained on the inner station in earlier years as 1 unit, the corresponding figure for 1953 is found to be 42.5. On the outer station in the same way we find that 1 unit earlier corresponds to 96.5 in 1953. In other words: in August 1953 there were more than 40 times more fish (by weight) on the inner station than there were on an average in the same month in 1925, 1927, 1928, and 1933, and, on the outer station there were nearly 100 times as much.

Arni Friðriksson.

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Saithe.

Occurrence of young Saithe off the North Coast of Iceland.

In the two last issues of Ann. Biol. (Vol. 8, pp. 42—44 and Vol. 9, pp. 43—45) a survey was given of purse-seine catches of young saithe off the north coast of Iceland in 1950—52 (summer). The origin of this type of fishery was described, and the size and age of the fish caught was recorded.

During August 1953 some saithe were caught as usual, but the yields were much poorer than in the previous year, totalling some few tons only (see also Ann. Biol., 9, p. 43). The larger fish were salted and the smaller ones reduced to oil and meal.

On 21. August 793 fish were measured from a catch of about 10 tons taken off the middle of the north coast. The length distribution was as follows:—

Cm.	No.	Cm.	No.
35—39	1	65—69	64
40—44	1	70—74	76
45—49	149	75—79	111
50—54	198	80—84	19
55—59	91	85—89	11
60—64	273	90—94	6

Unfortunately no scales or otoliths were collected for age analyses, and it was hoped that more samples could be dealt with later.

The length distribution is shown in Figure 46 and those for the fish examined in 1950—52 are also plotted for comparison (see Ann. Biol., 9, p. 44). In the length distribution for 1953 there are three distinctive maxima, marked A, B, and C on the figure, corresponding to the 50—54, 60—64, and 75—79 cm. length-groups respectively. It is clear that we are dealing with many year-classes, probably five, three of which are predominant. Comparing the 1953 curve with those from the previous years, where information on the age of the length groups is available, it becomes evident that peak A must be composed of many 4-year-olds, as in 1951, possibly mixed with a number of 3-year-old fish (see 1952). Peak B at 60—64 cm. is the most abundant and must be caused by the presence of many 5-year-olds as in 1950 and 1952. Finally peak C corresponds to the 7-year-old fish as observed in 1952, but there also seems to be a small number of 6-year-olds.

Therefore, the catches of saithe off north Iceland in August 1953 must have consisted

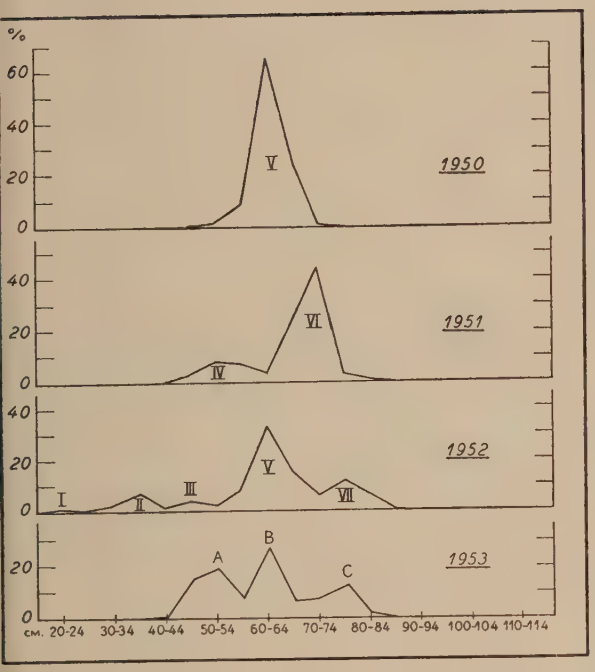


Figure 46. Length composition of saithe (cm. and %) caught by purse-seine off north Iceland in 1950—1953. The roman figures indicate age-groups.

of the following year-classes:— 1950 (3 years), 1949 (4 years), 1948 (5 years), 1947 (6 years), and 1946 (7 years). Some, very few, older fish may have occurred. It is interesting to note that there was hardly any coincidence between the age distribution in 1953 and in the previous years. The 1945 year-class, upon which the fishing was based in 1950 and 1951, and partly also in 1952, seemed to have entirely disappeared and the rather promising 1947 year-class was not dominant. The 4- and 5-year-olds which were dominant in the stock had not appeared abundant earlier. The poor yields in 1953 may therefore be due to the absence of the older stock and the lack of good young year-classes to replace it.

ARNI FRIÐRIKSSON.

Redfish.[1])

The Size Distribution of Redfish West of Iceland in 1953.

As in the three previous years material was collected from commercial trawler catches landed in Reykjavik and Akranes, and measurements were made onboard a trawler during one trip. Further observations were made on the research ship "Maria Julia", especially in Faxa Bay. However, only fish from the commercial catches will be dealt with here.

Altogether 3619 fish were measured in March (1000), September (492) and October (2127). A few (173) otoliths were taken for later age analyses. The first trip mentioned had been made to the usual fishing grounds, whereas the two other catches (Sept.—Oct.) were taken far off the W.-Coast, about 85 n.m. NW. off Snæfellsnes. Unfortunately we have no information on the yield per unit-of-effort, except for a rough estimate of the first trip which lasted 8 days (absence from port), and yielded 184 tons redfish or 23 tons per day's absence. This is a relatively very small yield (See Ann. Biol. 9, p. 64). As a valuable by-product the trawler caught 5 tons of cod per day.

As in the two earlier papers (Ann. Biol. 8 and 9) a survey of the length distribution is given in Table 14. As previously the material has been divided into "Large" (>50 cm.), "Large mediums" (45—49 cm.), "Small mediums" (40—44 cm.), and "Small" (<40 cm.). If we compare the figures in the table with those given in the corresponding table last year (Ann. Biol. 9, Table 14, p. 45) it appears that this year we are dealing with large fish, especially in September and October. This becomes evident if we consider the percentage of "Small" now and previously. In March this figure is lower than in any previous month of observation except for the two first ones, November 1950 and August 1951. There are relatively fewer "Small", especially in October, than in any earlier year in September and October. This appears very clearly from Figure 47.

Table 14. Size of the Icelandic Redfish in 1953 (%).

cm.	40 n.m. W. 10 SW. off Gardiskagi 25.III[1])	85 n.m. NW. off Snæfellsnes 17.IX.[1])	5.—6.X[2])
> 50	9.6	11.8	29.6
45—49	29.3	43.3	34.3
40—44	40.2	30.3	24.3
< 40	20.9	14.6	11.8
Total	100.0	100.0	100.0
N	1000	492	2127
M (cm.)	43.49	44.06	46.18

[1]) Dates of landing. [2]) Dates of fishing.

[1]) See also note on German landings of redfish, p. 37.

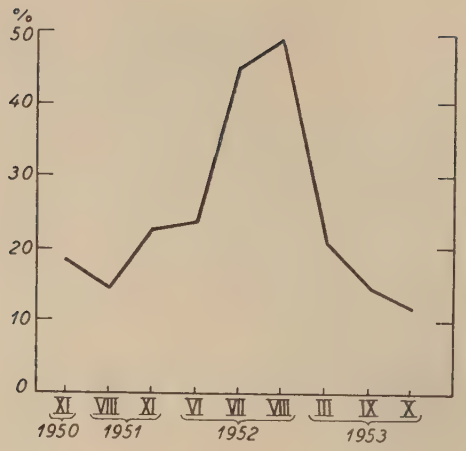


Figure 47.
Length distribution of redfish, percentage of »Small«.

Unfortunately, we are not yet in possession of observations covering all the months of the year, and there are only two months, August and November, where we have more than one observation. It may, however, be of some interest to point out that there seems to be some trend to a seasonal variation in the length composition of the stock as caught, as is shown in Figure 48. The percentage of "Small" is higher in July than in any other month, declines in August and reaches a minimum in September and October. In November, March and June it remains at about the same level, being a little more than 20%, but information is lacking from December, April and May. However, we have still far too few observations to allow any conclusions.

Mr. J. Magnusson, who was in charge of the collecting of material in September and October picked out the small fish caught in one or two hauls in October for special examination. The lot comprised 1302 fish—not included in the main material—and it is mentioned here, because the size distribution shows a very clear peak at 16 cm. The length ranged from 8—31 cm., covering 24 cm. altogether, but the peak

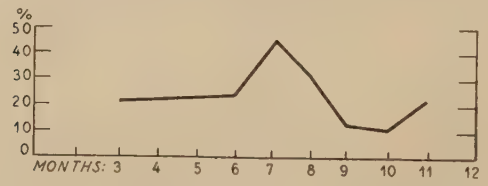


Figure 48. Seasonal variation in the length distribution of redfish, expressed as percentages of "Small".

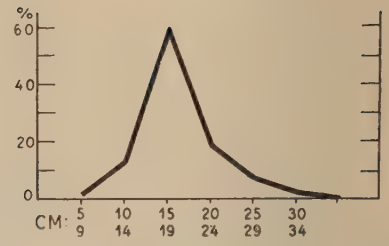


Figure 49. Length distribution of small redfish.

alone represented 260 individuals or 20% of the total number. This striking length distribution is seen clearly in Figure 49, which is based on the relative number of fish in each 5-cm. group. The shape of the curve (Figure 49) might or might not be due to the fact that the material was selected. However, it must be emphasized that redfish of a size as small as 16 cm. are extremely rare in deep-sea commercial catches off Iceland. Whether or no this peak represents a year-class is not easy to say although it probably might.

A. Friðriksson.

Rare Fishes.

German Records.

In 1953, the following rare fishes were received from Icelandic waters by the "Institut für Meeresforschung", Bremerhaven (IFM), the "Biologische Anstalt Helgoland", Department of Fishery Biology, Bremerhaven (BAH), and the "Institut für Seefischerei", Hamburg (IS).

1. *Alepocephalus bairdii* Goode & Bean 1879
   11.6.1953, Rose-Garden, 63°10′N.—12°02′W., 450 m. depth, 1 specimen, 86 cm. (IS).
2. *Aphanopus schmidti* Sæmundsson 1907
   24. 5. 1953, Rose-Garden, 2 specimens (IFM).
3. *Beryx decadactylus* C. & V. 1829
   11. 1. 1953, NW.-Iceland, 65°45′N.—26°30′W., 1 specimen, 50 cm. (BAH).
   30. 3. 1953, SW.-Iceland, 63°48′N.—26°12′W., 1 specimen, 56 cm. (BAH).
   14. 4. 1953, Iceland (no position), 1 specimen (IFM).
   15. 5. 1953, SW.-Iceland, 1 specimen, 57 cm. (BAH).
   1. 7. 1953, Rose-Garden, 1 specimen (IFM).
   29. 8. 1953, Rose-Garden, 1 specimen, 57 cm. (IS).
4. *Brama rayi* (Bloch 1791)
   25. 8. 1953, Rose-Garden, 1 specimen (IFM).
   21. 8. 1953, Iceland (Vestmannaeyja), 21°W., 28 specimens (IFM).
   2. 9. 1953, Rose-Garden, 1 specimen, (BAH).
   8. 9. 1953, Iceland (Vestmannaeyja), about 50—60 specimens (BAH).
   14. 9. 1953, Rose-Garden, 3 specimens (IFM).
   28. 9. 1953, SW.-Iceland, 3 specimens (IFM).
   30. 9. 1953, Iceland (Vestmannaeyja) 6 specimens (IFM).

1. 10. 1953, Iceland (Vestmannaeyja) 1 specimen (IFM).
15. 10. 1953, Iceland, 10 n. m. W. of Vestmannaeyja, 1 specimen (IFM).

5. *Centroscymnus coelolepis* Bocage & Capello 1864
6. 6. 1953, Rose-Garden, 1 specimen, female, 106 cm. (BAH).
10. 6. 1953, Rose-Garden, 1 specimen, male, 95 cm. (BAH).
11. 6. 1953, Rose-Garden, 63°10′N.—12°02′W., 450 m. depth, 1 specimen, female, 112 cm. (IS).

6. *Deania calceus* (Lowe 1839)
10. 6. 1953, Rose-Garden, 1 specimen, female, 112 cm. (BAH).
11. 6. 1953, Rose-Garden, 63°10′N.—12°02′W., 450 m. depth, 1 specimen, female, 111 cm. (IS).

7. *Nemichthys scolopacea* Richardson 1848
21. 5. 1953, Rose-Garden, 2 specimens (IFM).

8. *Nesiarchus nasutus* Johnson 1862
29. 8. 1953, Rose-Garden, 1 specimen, 78 cm. (IS).

9. *Notacanthus phasganorus* Goode 1881
26. 5. 1953, Rose-Garden, 2 specimens (IFM).
8. 6. 1953, Rose-Garden, 1 specimen (IFM).
18. 8. 1953, Rose-Garden, 1 specimen, 78 cm. (IS).
25. 8. 1953, Rose-Garden, 4 specimens (IFM).

10. *Scorpaena dactyloptera* de Laroche 1809
16. 5. 1953, Rose-Garden, 1 specimen (IFM).

11. *Scymnodon ringens* Bocage & Capello 1864 (Syn. *Centroscymnus obscurus* Vaillant 1888)
6. 6. 1953, Rose-Garden, 1 specimen, female, 79 cm. (BAH).

12. *Searsia schnakenbecki* Krefft 1953
4. 6. 1953, Rose-Garden, 1 specimen, 16.5 cm. (IFM).

13. *Stomias ferrox* Reinhardt 1842
4. 6. 1953, Rose-Garden, 1 specimen, 13.4 cm. (IFM).

Identifications by: —

C. H. Brandes,
A. Kotthaus,
G. Krefft.

Scottish Records.

The following rare fishes were landed at Aberdeen by commercial vessels from fishing grounds in the North-Western Area during 1953.

Raia lintea, Fries:— two specimens from SW. and W. Iceland in July and August respectively. This species although stated by Sæmundsson to be rare is not uncommon in great line catches for this area but it is considered of no commercial value and accordingly is seldom landed.

Argentina silus (Ascanius):— 35 cwt. of this fish were landed at Aberdeen by a Belgian trawler on 23. June from 25′ SSE. of Ingolfshöfdi Huk. Although not uncommon on S. Icelandic grounds this species is not always taken in such quantity as on this occasion.

Further details of these records together with records from the boundary regions with the North Sea are included in a short paper on rare and exotic fishes landed in Scotland in 1953 which is being prepared for publication in *The Scottish Naturalist*.

B. B. Rae and E. Wilson.

Cod. **Greenland.**

Cod in West-Greenland Coastal Waters and Offshore Banks 1953.

1. Occurrence of cod eggs and larvae. (See Figure 50).

From information given by Greenland fishermen and from catches of cod eggs and larvae by 1 and 2m. stramin nets from the "Adolf Jensen" and the "Dana" it appears that the cod spawned earlier than usual.

Figure 50. Catches of cod larvae by "Dana", July 1953.

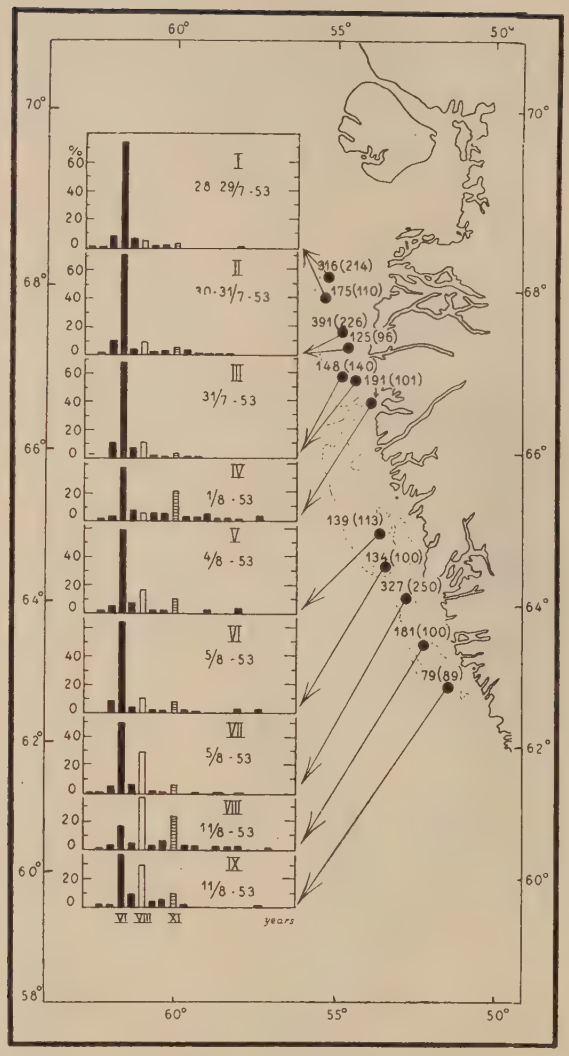


Figure 51. Composition of year-classes, off-shore banks.

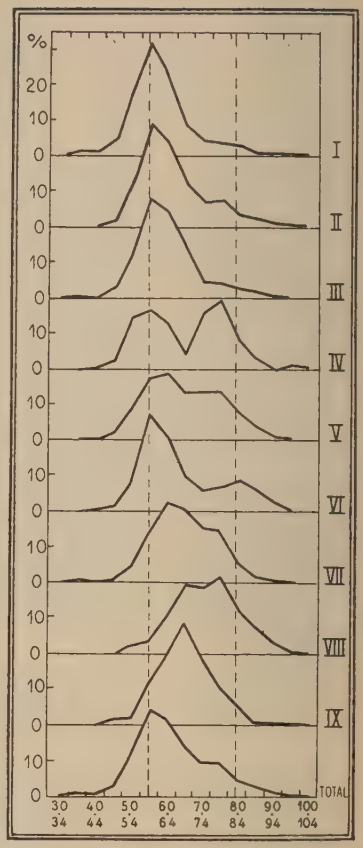


Figure 52. Length distributions, 1953.

At the end of June practically no cod eggs and larvae were found in the Godthåbfjord, in the coastal area outside the fjord, or on Fylla Bank. At that time the cod fry had already been transported by the current out of the fjord and northwards.

The catches of cod larvae from the "Dana"'s hauls by the 2m. stramin net are given in Figure 50. The numbers of larvae taken when hauling the net with 100 m. of wire out to the surface, and with 200 m. of wire out to 100 m. are shown above and below the line respectively. It is seen that the largest numbers of larvae were taken between 65°N. and 68°20'N., which is a rather northerly distribution.

In contrast to 1950 and 1952, no larvae were taken south of 64°N., which indicates that there has been no transport to the Davis Strait of cod fry from spawning grounds situated east of Cape Farewell (e.g., Iceland).

The lengths of the cod larvae were between 9—31 mm. The mean length was 16.8 mm.

2. Composition of year-classes in catches of cod.
(See Figures 51 and 53 and Tables 15 and 16).

a) Offshore banks.

In offshore waters 2573 cod otolith samples have been collected. Included in these samples are 2187 collected by the "Dana" from catches taken with hand-lines in depths between 30—75 m. on the fishing banks.

The remaining 386 were taken with long-

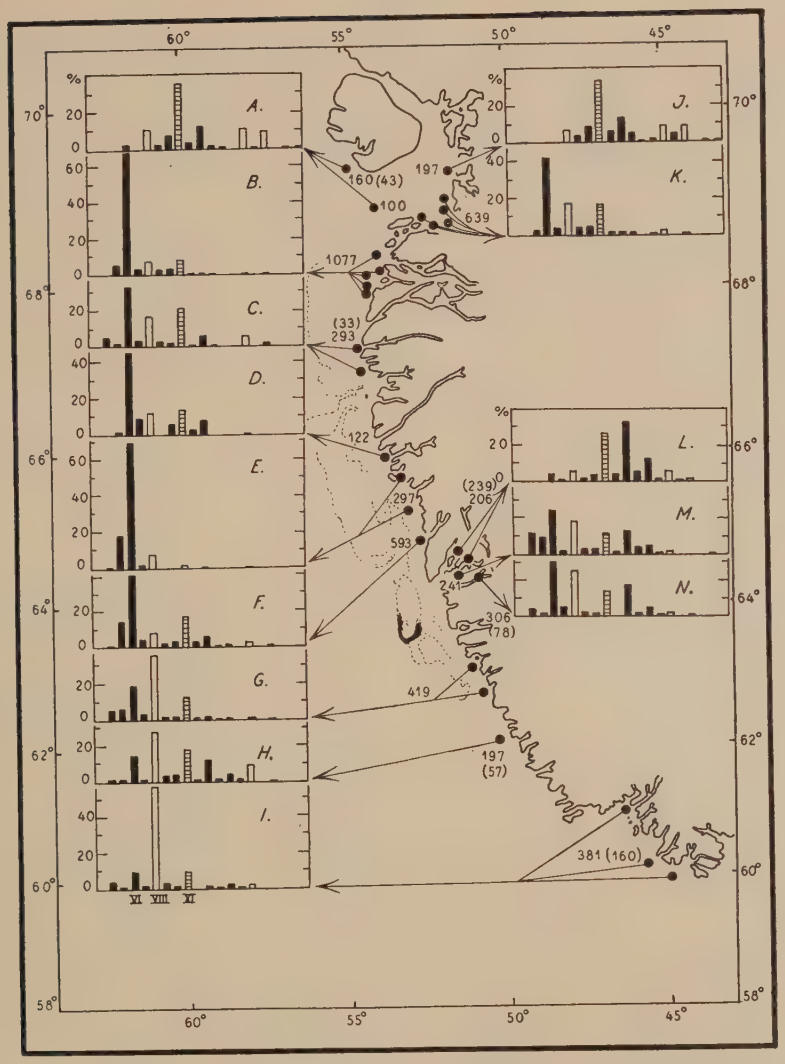


Figure 53. Composition of year-classes, coastal waters and fjords, 1953.

lines during fishing experiments carried out in offshore waters by the "Adolf Jensen".

The results of the age analysis are given in Figure 51 and in the table. As would be expected, only three rich year-classes occurred in the catches in 1953.

It appears from Figure 51 that the 1947 year-class has been the predominant year-class in all the samples with one exception (No. VIII).

From about 68°10′N. to 64°30′N., on the banks, the 1947 year-class has been exceptionally strong, amounting to more than 60% in three of the samples, and between 50 and 60% in two.

The 1945 year-class, which has been of some importance in the catches in previous years, was only well represented in the three southern samples. On Fiskenæs Bank (VIII) it was the strongest year-class in the catch. As in 1952, this year-class seemed to be most richly represented in the southern part of the region.

The 1942 year-class was only found dominant in the sample taken south-west and south of Disko (see Figure 53A), where it amounted to more than 35% of the catch. In the other

Table 15.

Year-class	Age-group	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.	N.
1949.....	IV	—	—	5.1	—	0.3	0.2	4.8	0.5	3.7	—	0.2	—	11.6	2.9
1948.....	V	—	5.4	1.4	1.6	17.8	12.6	5.7	0.5	0.5	—	2.3	—	8.3	1.3
1947.....	VI	2.3	68.4	33.1	45.9	69.7	40.0	29.4	14.2	19.9	—	42.1	2.9	22.8	28.4
1946.....	VII	—	2.8	3.1	9.0	2.0	2.9	3.6	1.0	1.0	—	4.2	0.5	2.1	3.3
1945.....	VIII	10.7	6.8	17.0	13.1	7.4	9.1	36.3	27.4	56.2	7.1	18.3	5.8	18.3	23.9
1944.....	IX	2.7	2.6	3.1	—	—	1.9	1.7	3.0	2.6	3.0	3.4	1.9	2.1	1.0
1943.....	X	7.3	3.2	1.7	5.7	—	2.4	1.7	4.6	1.5	7.6	4.7	2.4	2.5	0.7
1942.....	XI	36.6	7.8	21.5	13.9	1.7	17.7	12.2	17.8	9.7	33.5	17.5	26.2	10.8	13.4
1941.....	XII	3.1	1.0	0.3	2.5	—	2.5	0.7	1.0	—	5.6	1.1	2.4	0.4	—
1940.....	XIII	13.0	0.5	6.1	7.4	0.6	5.2	1.4	11.7	0.8	12.7	1.4	32.0	12.0	16.7
1939.....	XIV	1.5	0.4	0.7	—	—	0.3	0.5	2.0	0.5	4.6	0.9	4.4	3.3	1.3
1938.....	XV	1.5	—	—	—	—	0.8	1.0	4.1	1.8	0.5	—	12.1	3.7	3.9
1937.....	XVI	—	—	—	—	—	—	—	1.5	0.3	1.5	0.3	0.5	0.4	1.0
1936.....	XVII	10.7	0.7	5.5	0.8	0.3	3.5	1.0	9.6	1.3	9.6	2.2	6.3	1.2	2.0
1935.....	XVIII	0.4	—	—	—	—	—	—	—	—	4.1	—	0.5	—	—
1934.....	XIX	9.5	0.2	1.4	—	—	0.8	0.2	1.0	—	9.1	0.8	1.9	—	0.3
1933.....	XX	—	—	—	—	—	—	—	—	—	—	-	—	—	—
1932.....	XXI	0.4	—	—	—	—	—	—	—	—	0.5	—	—	0.4	—
1931.....	XXII	0.4	—	—	—	—	—	—	—	—	0.5	—	—	- -	—
Number.....		262	1072	293	122	297	593	419	197	381	197	639	206	241	306

samples it was of slight importance, with exception of the long-line catch in the Holsteinsborg Deep (IV) (depth 120—200 m.) and on Fiskenæs Bank (VIII), where it amounted to 20.4, and 24% respectively.

b. Coastal waters and fjords.

A total of 5482 otolith samples have been collected, partly by fishing experiments from the "Adolf Jensen", and partly from the Greenlanders' catches at the different fisheries stations along the Greenland coast from Cape Farewell to Umanak. The results of the age analyses of these samples are given in Figure 53. Many of the analyses given on the map include samples taken at different times in the season from May to November (mostly July to September). The samples from each station, however, are very similar with respect to the composition of year-classes, even when taken at different times during the season. Therefore, there can be no objection to treating them together.

It can be seen that the 1942 year-class dominates the samples from the northern part of Disko Bay and the catches south-west and south of Disko (J, A), while the 1947 year-class is the dominant year-class in the coastal area from about 68°N. to about 64°N. (B, C, D, E, F). South of 64°N., the dominant year-class is the 1945 year-class, which amounts to about 56% in the catches from Julianehåb district (I).

These results are in good agreement with the age analyses from the offshore banks (see Figure 51). From Godthåbsfjord we have two different samples, one taken in May—June from the outer part of the fjord (M),and one in October—November from the inner part of the fjord (L). In the first sample the 1947 year-class is dominant with 22.8%, next in importance is the 1945 year-class (18.3%), while the 1940 year-class contributes 12.0% of the total.

The sample from the inner part of the fjord has the 1940 year-class as the richest one (32 %), then the 1942 year-class as the next best (26.2%), and the 1938 year-class as third (12.1%) in abundance. In this sample the otoliths are of the special "fjord type" with many secondary rings, while the otoliths from other samples are rather similar to those found in the coastal area. It may be assumed that the sample from the inner part of the fjord consists of cod belonging to the special fjord population, while the sample from the outer part of the fjord mainly consists of cod from the coastal area.

The Ameralik Fjord is a fjord where cod from both the coastal region and from the banks spawn in the springtime and pursue the capelin just after the spawning. In 1953 a pound-net fishery for cod was carried out by The Royal Greenland Board of Trade. The yield of the fishery was poor, owing to the early spawning of the cod, and also to the fact that the capelin spawned in the fjord in other places than in the warm interior where the pound-net fishery was carried out. The fishery was stopped in the beginning of June, when most

of the fish caught in the nets were undersized cod belonging to the 1947 year-class (N).

A large number of cod belonging to the 1947 year-class was found in one of the small branches of Umanak Fjord, Sermerdlit, 70°34′N., 50°43′W. (not shown on the map in Figure 53.) In a sample of 78 otoliths, 93.6% belonged to this year-class. The cod were taken by jigs and by net. The mean length of cod belonging to the 1947 year-class was only 54.9 cm., which is the lowest mean length for that year-class found in 1953. It is the first time that cod of medium age have been seen in Umanak district, where, since 1948, only very old cod and codlings one or two years old have been found. The cod belonging to the 1947 year-class were still immature in 1953. Spawning of cod has never been observed in this northern district. It may, therefore, be expected that when cod belonging to the 1947 year-class reach maturity, which will probably happen in 1954 or 1955, a migration will take place to spawning places in the southern part of Davis Strait.

3. Length measurements of cod from the banks.

The length distributions of cod taken on the offshore banks are shown in Figure 52 in 5-cm. groups. The roman numerals correspond with those on the map in Figure 51. The last curve shows the measurements from all the samples. The peaks of the curves correspond well with the occurrence of the dominant year-classes. The mean lengths of cod belonging to the different year-classes in the samples from the offshore banks are given in Table 15. It is evident that the mean lengths are very low.

The mean lengths of the 1947 year-class are from 55.8 cm. to 59.6 cm. on the Store and Lille Hellefiske Banks, and little more than 60 cm. on the southern banks. On the northern part of Store Hellefiske Bank these small cod were very lean and had small livers, which indicates poor condition. In the catch from the northernmost station many specimens were badly infected in the gills by parasitic copepods. Probably a large number of cod belonging to the 1947 year-class have immigrated to the northern banks from Disko Bay and Umanak Fjord, where they have spent their first four years of life.

4. Tagging experiments with cod.

1539 cod were tagged on the offshore banks onboard the "Dana" in 1953. The number of cod tagged at the different stations are given in brackets on the map in Figure 51. Ebonite tags were used in the experiments, with exception of 37 cod which were tagged with yellow Nocathene tags. In coastal waters and in fjords 941 cod were tagged onboard the "Adolf Jensen". The numbers, in brackets, of cod tagged in the different localities are given in Figure 53. In addition to those given on the map, 151 cod were tagged in the inner part of Umanak Fjord (about 70°34′N.).

Of the cod tagged in 1953, 52 were recaptured in the same year. Nearly all were recaptured near the place of the tagging. Only in three cases were recaptures taken some distance from the tagging locality, namely, one recaptured on Store Hellefiske Bank, which was tagged on Lille Hellefiske Bank, and two tagged in Ameralik Fjord, which were recaptured later on Fylla Bank and on Store Hellefiske Bank respectively.

Among the recaptures taken near the tagging place, 23 were taken on Store Hellefiske Bank, 1 on Lille Hellefiske Bank (Banana Bank), and 5 on Fylla Bank, while 18 were taken in Ameralik Fjord and 2 in Godthåbfjord.

Recaptures from tagging experiments in other years were as follows:—

Year of tagging	Recaptured in 1953	
	Greenland	Iceland
1947.....	—	1
1948.....	7	2
1949.....	11	8
1950.....	11	1
1951.....	11	5
1952.....	117	9
Total.....	157	26

The number of recaptures from Iceland was higher than in 1952 but insignificant compared with the number of recaptures from Greenland. From all the recaptures in 1953 (cod tagged in 1953 omitted) the recaptures from Iceland alone amounted to 14.2% against 13.9% in 1952. These percentages are thus very similar.

Considering the large number of cod which have recently been tagged at Greenland the number of recaptures at Iceland has not been very high in 1953. They can in no way be compared with the numbers from the years before the war when in 1933, 1934, 1938, and 1939 the corresponding percentages of recaptures from Iceland amounted to 73.1, 67.1, 48.8, and 51.2% respectively.

Table 16.

Year-class	Store Hellefiske Bank 68°01′N. 55°04′W. and 67°54′N. 55°20′W. 29. and 30. July		Store Hellefiske Bank 67°29′N. 54°42′W. and 67°22′N. 54°16′W. 30. and 31. July		Store Hellefiske Bank 66°51′N. 54°38′W. and 66°51′N. 54°20′W. 1. August		Holsteinsborg Deep 66°30′N. 53°55′W. 19. July		Lille Hellefiske Bank 65°02′N. 53°24′W. 4. and 5. August		Banana Bank 64°28′N. 53°13′W. 5. August		Fylla Bank 64°07′N. 52°40′W. 5. August		Fiskenæs Bank 63°29′N. 52°03′W. 11. August		Dana Bank 62°45′N. 51°11′W. 11. August		Age-group
	%	cm.	%	cm.	%	cm.	%	cm.	%	cm.	%	cm.	%	cm.	%	cm.	%	cm.	
1950	—	(37.1)	—	—	—	(35.7)	—	—	—	—	—	—	—	(37.0)	—	—	—	—	III
1949	0.6	(43.8)	0.4	(41.5)	—	—	0.7	(45.0)	0.7	(46.0)	—	—	0.6	(47.0)	0.6	(50.0)	2.5	(47.0)	IV
1948	8.3	50.9	9.2	52.8	10.3	51.5	2.1	(50.0)	3.6	49.3	7.5	52.9	4.3	53.6	1.7	(52.0)	1.3	(51.0)	V
1947	75.1	57.5	67.2	59.3	69.4	59.6	37.6	55.8	58.4	58.9	62.7	60.0	51.7	61.4	16.8	61.7	35.4	60.5	VI
1946	6.2	64.2	3.7	69.2	5.5	64.7	7.1	64.8	5.1	63.2	3.0	(66.5)	5.8	66.4	3.4	66.7	8.9	64.5	VII
1945	3.5	71.0	9.6	74.7	10.6	69.9	5.0	68.5	16.1	72.4	9.7	71.7	29.8	72.8	38.5	72.3	31.6	69.8	VIII
1944	1.0	73.2	1.4	78.3	0.9	(73.5)	6.4	71.1	1.5	(77.5)	2.2	(76.5)	1.2	(74.9)	2.8	80.0	3.8	(70.7)	IX
1943	1.2	72.5	2.1	80.2	0.6	(75.0)	4.3	76.2	1.5	(74.5)	1.5	(77.5)	0.6	(76.0)	5.0	73.7	5.1	(69.5)	X
1942	2.5	77.7	5.1	83.0	2.1	86.5	20.6	77.4	8.8	77.4	6.7	82.6	4.6	76.9	24.0	77.5	8.9	76.0	XI
1941	—	—	1.0	88.7	0.3	(90.0)	2.8	(81.0)	—	—	1.5	(78.5)	—	—	2.2	(79.9)	1.3	(83.0)	XII
1940	0.2	(81.0)	—	—	0.3	(90.0)	2.8	(72.5)	—	—	0.7	(87.0)	0.3	(77.0)	1.1	(84.5)	—	—	XIII
1939	—	—	0.4	(93.0)	—	—	5.0	82.2	1.5	(87.0)	—	—	—	—	—	—	—	—	XIV
1938	—	—	—	—	—	—	0.7	(82.0)	—	—	—	—	0.3	(79.0)	1.1	(83.5)	—	—	XV
1937	—	—	—	—	—	—	1.4	(78.5)	—	—	—	—	—	—	0.6	(92.0)	—	—	XVI
1936	1.2	87.0	—	—	—	—	0.7	(77.0)	2.9	(87.5)	3.0	(87.5)	0.6	(85.0)	1.7	(85.7)	—	—	XVII
1935	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	XVIII
1934	—	—	—	—	—	—	2.8	(100.2)	—	—	1.5	(83.0)	—	—	—	—	1.3	(99.0)	IXX
1933	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.6	(99.0)	—	—	XX
Number:	482		513		330		141		137		134		325		179		79		
Depth, m.:	40		32—29		33—38		120—200		52		48		40		53		58		
Temp. °C.:	2.88		3.49—3.11		3.72		—		1.84		2.23		3.11		1.61		1.05		

Among the recaptures from Iceland, 17 have been tagged in Julianehåb district, 1 in Frederikshåb district, 1 in Ameralik Fjord, 1 in Sukkertoppen district, 2 in Disko Bay, 3 on Fylla Bank and 1 on Lille Hellefiske Bank.

It is seen that as in previous years the largest numbers of recaptures from Iceland originate from taggings in Julianehåb district.

Otoliths have been taken from twenty-two of the cod recaptured in Icelandic waters. The age analyses gave the following results:—

Year-class	Age-group	1947	—48	—49	—50	—51	—52	Total
1940	XIII	—	1	—	—	—	—	1
1942	XI	1	—	3	—	2	1	7
1943	X	—	1	2	—	—	—	3
1944	IX	—	—	—	—	2	1	3
1945	VIII	—	—	—	1	3	4	8
Total		1	2	5	1	7	6	22

It is seen that the largest numbers of recaptures from Iceland belong to the rich 1942 and 1945 year-classes.

In the 1952 report it was mentioned that small cod tagged with Lea tags in 1949 in the northern part of the area, Umanak Fjord and Disko Bay, were recaptured in more southerly localities in 1951 (two recaptures) and in 1952 (one recapture). In 1953 two more tagged cod were recaptured a long distance south of the tagging locality. One, tagged in Umanak harbour 70°40′N., 52°00′W. on 6. August 1949, was recaptured on Fylla Bank 64°09′N., 52°57′W. 11. August 1953. It was 24 cm. when tagged and must have belonged to the 1947 year-class. The reported length at recapture was not reliable. The distance of migration was about 460 miles. The other cod was tagged off Christianshåb, 68°50′N., 51°10′W., on 26. August 1949. The length when tagged was 24 cm. and the cod must have belonged to the 1947 year-class. The cod was recaptured on Store Hellefiske Bank 67°41′N., 55°00′W., 18. July 1953, 120 miles south of the tagging locality. The length of the cod at the time of recapture was reported to be 46 cm. These two cod were recaptured by Portuguese fishermen. As was mentioned in the 1952 report these recaptures in southern localities were from the 1949 tagging experiments with small cod in the northern localities, where enormous quantities of small cod of the 1947 year-class occurred in that year. The results indicate that intensive southward migrations have taken place in recent years. In addition, these successful experiments prove that Lea tags can be very useful for tagging cod belonging to the youngest year-classes.

In 1952 a tagging experiment was carried out with 368 cod, which belonged mainly to the 1947 year-class. The cod were taken in pound-nets in Amerdlok Fjord and transported to Holsteinsborg harbour, where they were tagged and released. To date, 20 recaptures have been reported. They are as follows:—

	Recaptured		
Year of recapture	Banks	Fjords	Total
1952.....	7	4	11
1953.....	5	4	9
	12	8	20

It is seen that twelve of the recaptures were from the offshore banks; eleven were from Store Hellefiske Bank and one from Fylla Bank

It appears from the experiment that the stock of small cod which grows up in the fjord and coastal area, contributed to the dense aggregation of the 1947 year-class on the adjacent bank.

From the age analyses it is seen that the 1947 year-class has been particularly abundant in the coastal area from about 69°N. to about 64°N., and therefore it may be assumed that this year-class, which is now dominant on the Store Hellefiske Bank, Lille Hellefiske Bank and Fylla Bank must have had considerable recruitment from the adjacent coastal areas. Furthermore it may be expected that by migration from the coastal waters and the fjords the numbers of the 1947 year-class will increase on the banks during the next few years.

P. M. Hansen.

German Cod Investigations.

German trawlers made only four trips to Greenland. The catch of cod in the south (Noname Bank to Julianehåb) was especially disappointing. Age determinations showed that the age composition was almost the same as in 1952 in the south. The 1945 year-class showed a remarkable increase in length from 69 cm. in January 1953 to 79 cm. in September 1953 (average 235 specimens).

During May to July on the Fylla Bank the 1947 year-class comprised up to 75 %. In this area the 1945 year-class gave a very small yield in contrast to the good catches of 1952. Thus the question arises of the location of the

Table 17. Age Composition of German Cod Catches.

	West Greenland 1952 (June)	West Greenland 1953 (May)	South Greenland 1953 (January)	South Greenland 1953 (Sept.)
Year-class	‰	‰	‰	‰
1949....	—	—	1	20
1948....	1	58	3	19
1947....	167	749	52	105
1946....	175	36	11	16
1945....	490	125	662	610
1944....	79	12	39	29
1943....	40	7	63	33
1942....	39	11	128	97
1941....	9	1	1	8
1940....	—	1	16	20
1939....	—	—	3	13
1938....	—	—	1	6
1937....	—	—	5	2
1936....	—	—	8	11
1935....	—	—	—	—
1934....	—	—	7	7
older....	—	—	—	4

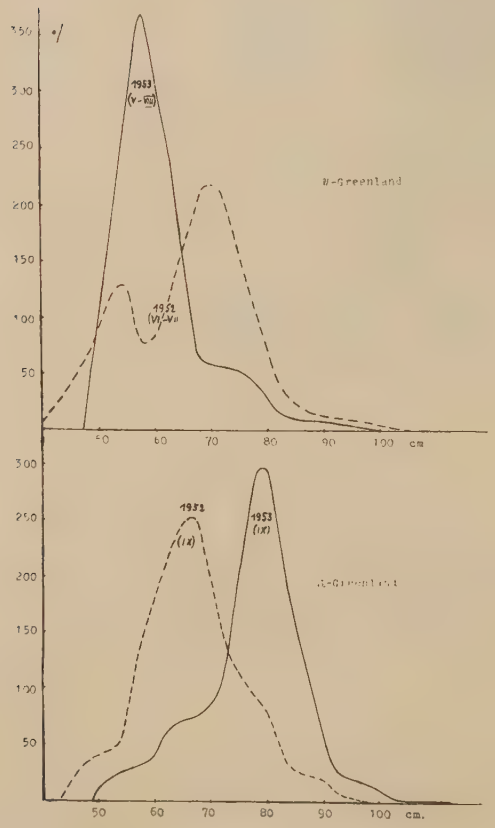


Figure 54. Length composition of German cod landings from West and South Greenland in 1952 and 1953.

1945 year-class, the bulk of which was found ready for spawning when the last trawler left Cape Farewell in January 1953.

ARNO MEYER.

The Trawl-Caught Cod on the West Greenland Banks in 1953.

During a trip which lasted from 27. July to 6. September 1953 a large collection of otoliths and length measurements was made by Mr. EYJOLFUR THORODDSEN on board the Icelandic trawler "Pétur Halldörsson". The trawler was fishing mainly on the Fylla Bank and the material presented here is all from this locality. The samples consist of length measurements, otoliths with length, sex and sexual maturity, and also otoliths taken from waste heads. Most of the samples are from fish which were used for salting, but there were also some samples taken of the fish which were converted into fish meal.

Age composition and onset of maturity.

The sexual maturity was recorded for about two thousand cod which were also analysed with regard to age. At this time of the year the gonads were immature or spent. The following figures give the percentages of spent fish in each age-group, together with the total number in each age-group.

Age-Gr.	4	5	6	7	8	9	10
Total No.	11	56	826	201	700	61	61
% spent	27	50	74	80	93	93	100

These figures may not be representative for the stocks as a whole, but they clearly show that the Greenland cod becomes mature at a remarkably young age.

From the above we have also calculated the percentages of spent fish in each 5-cm. group:—

5-cm. Gr.	45	50	55	60	65	70	75	80
% spent	17	37	61	61	79	91	95	100

In Table 18 the age determinations have been arranged by age-groups and age at first spawning. The table at once reveals the fact that the major part of the catch consists of first time spawners. The age composition of these is completely dominated by the 1945 and 1947 year-classes. The 1942 year-class, now 11 years old, is only represented by mature individuals. The greatest part of it became

Table 18. Age Composition of Trawl-Caught Cod on Fylla Bank 30. July - 15. August 1953.

Age-group	Age at first spawning 4	5	6	7	8	9	10	11		Im-mat.	Mature No.	%	Total No.	%
III	—	—	—	—	—	—	—	—	1	—	—	—	1	0.1
IV	—	—	—	—	—	—	—	—	—	—	—	—	—	—
V	—	8	—	—	—	—	—	—	1	10	8	0.5	19	1.0
VI	1	5	556	—	—	—	—	—	6	209	562	35.6	777	39.8
VII	—	1	7	160	—	—	—	—	3	30	168	10.6	201	10.3
VIII	—	2	16	72	534	—	—	—	29	47	624	39.5	700	35.9
IX	—	—	4	11	13	25	—	—	4	4	53	3.4	61	3.1
X	—	—	2	14	17	5	10	—	13	—	48	3.0	61	3.1
XI	—	1	4	24	49	10	1	1	10	—	90	5.7	100	5.1
XII	—	—	—	2	4	—	—	—	2	—	6	0.4	8	0.4
XIII	—	—	—	—	—	—	—	—	2	—	—	—	2	0.2
XIV	—	—	1	1	—	1	1	—	—	—	4	0.3	4	0.2
XV	—	—	—	—	—	—	1	—	—	—	1	0.1	1	0.1
XVI	—	—	—	3	5	2	2	1	—	—	13	0.8	13	0.7
XVII	—	—	1	—	—	—	—	—	—	—	1	0.1	1	0.1
XVIII	—	—	—	1	—	—	—	—	—	—	1	0.1	1	0.1
Total No.	1	17	591	288	622	43	15	2	71	300	1579		1950	
%	0.1	1.1	37.4	18.2	39.4	2.7	0.9	0.1	3.6	15.4				

Spawning classes	1	2	3	4	5	6	7	8	9	10	11	12
No.	1294	103	56	69	31	9	3	3	6	3	—	2
%	82.0	6.5	3.5	4.4	2.0	0.6	0.2	0.2	0.4	0.2	—	0.1

mature as 8 years old and from Table 18 its average age at first spawning was 7.8 years. This is in agreement with Dr. P. M. HANSEN's results. For the 1932, '34 and '36 year-classes he gives the following ages at first spawning: 8.1, 7.8, and 7.6 years.

From the second spawning class onwards there is a relatively regular decrease in number, except for the fourth spawning class which is the result of a great spawning of the 1942 year-class as 8 years old.

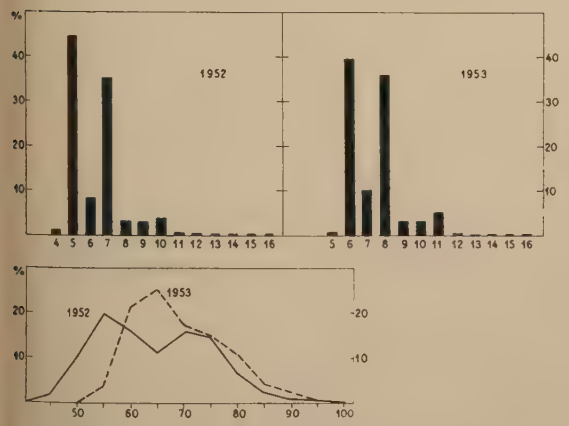


Figure 55. Age and length composition of cod from Fylla Bank, 1952 and 1953.

The age composition of the stock as a whole is in a good agreement with the results obtained in 1952. The 1945 and 1947 year-classes are the most abundant. If we compare our figures from this year with the figures from Fylla Bank in 1952 we get the following:

	1945 Year-class	1946 Year-class	1947 Year-class
1952	35.3 %	8.3 %	44.5 %
1953	35.9 %	10.3 %	39.8 %

The ratio between these three year-classes is almost the same in both years. The age- and

Table 19. Mean Lengths of the Various Age-Groups on Fylla Bank.

Age	♀♀ No.	♀♀ cm.	♂♂ No.	♂♂ cm.
3	1	60.0	—	—
4	4	49.0	7	47.4
5	28	54.8	28	54.3
6	397	63.7	429	62.9
7	99	68.9	102	67.1
8	365	75.7	335	73.3
9	27	76.4	34	74.9
10	29	80.1	32	75.2
11	32	79.9	68	77.9
12	5	81.0	3	80.3
13	1	81.0	1	78.0
14	4	82.0	—	—
15	1	82.0	—	—
16	6	83.5	7	82.0
17	1	85.0	—	—
18	1	85.0	—	—

length composition of the fish from Fylla Bank in 1952 and 1953 is shown graphically in Figure 55.

The lack of fish older than 11 years is very conspicuous and is in a good agreement with the age composition of the Icelandic stock of cod.

The growth rate.

The average lengths of the various year-groups on Fylla Bank during the period 30. July to 15. August 1953 are listed in Table 19.

From these figures the average growth of the 1947 year-class in the period October 1952 to August 1953 was 8.4 cm. The values for the 1946 and 1945 year-classes are 4.7 cm. and 2.8 cm. respectively.

JÓN JÓNSSON.

The Pelagic Long-Line Fishery in the Holsteinsborg Deep.

In the 1953 season altogether 54 Norwegian vessels took part in the Greenland fishery. The total catch was about 10,000 tons of salted cod. As in previous years the Institute of Marine Research had sent observers on board a commercial vessel to collect material from the cod fishery and the temperature conditions on the banks. The observers were BIRGER RASMUSSEN and ALFRED FRÖLAND who started field work on 21. July.

The trend of the fishery.

During May the Norwegian vessels had been long-lining on the western slopes of Fiskenes, Dana, Fylla and Banan Banks where the fishery had been very satisfactory. In June-July the cod seemed to disappear from these localities, and a part of the fleet transferred their fishery to the banks off Cape Farewell—Frederikshåb. Towards the end of July and in August good catches could be made in the shallow parts of the banks, but the cod were generally so small that long-lining was considered unprofitable for that reason. The whole fleet finally concentrated their activities in the Holsteinsborg Deep till the end of August when large cod reappeared along the slopes of the banks.

On 12.—13. August temperature observations were taken by means of a bathythermograph registering down to 270 metres. Three sections were taken across the banks, viz., one westwards from the northern edge of the Lille Hellefiske Bank, one westwards from the shallow part of the Lille Hellefiske Bank, and one section westwards from Fylla Bank. In Figures 56 and 57 are shown the temperature conditions in the two latter localities together with corresponding observations in previous years.

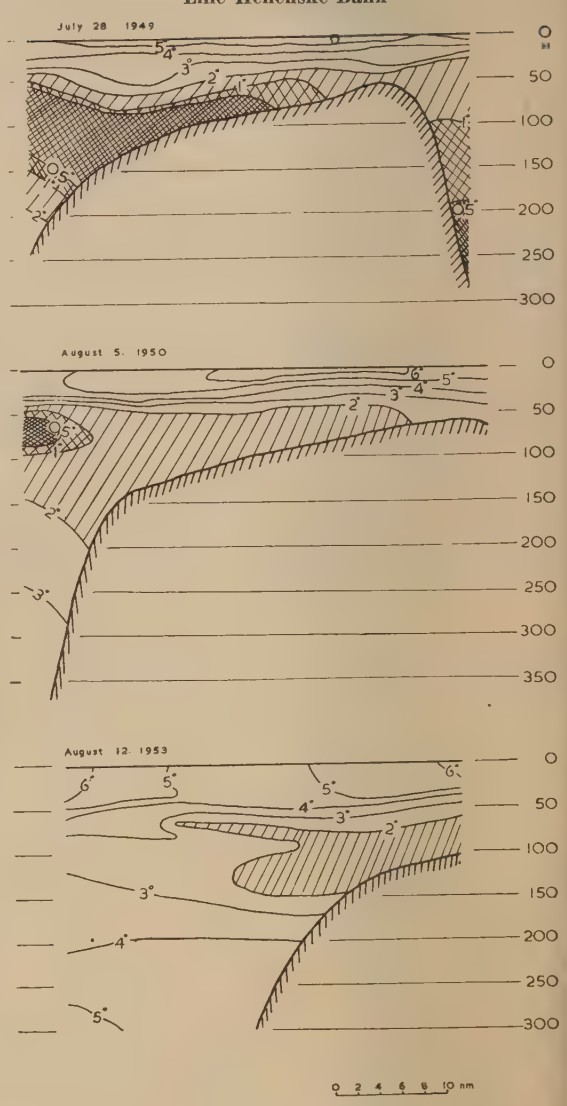


Figure 56. Temperatures in 1949, 1950 and 1953.

In 1953 the temperatures were unusually high compared with the conditions in earlier years. In depths of 150—200 m. on the western slopes where long-lining usually takes place, the bottom temperature on Lille Hellefiske

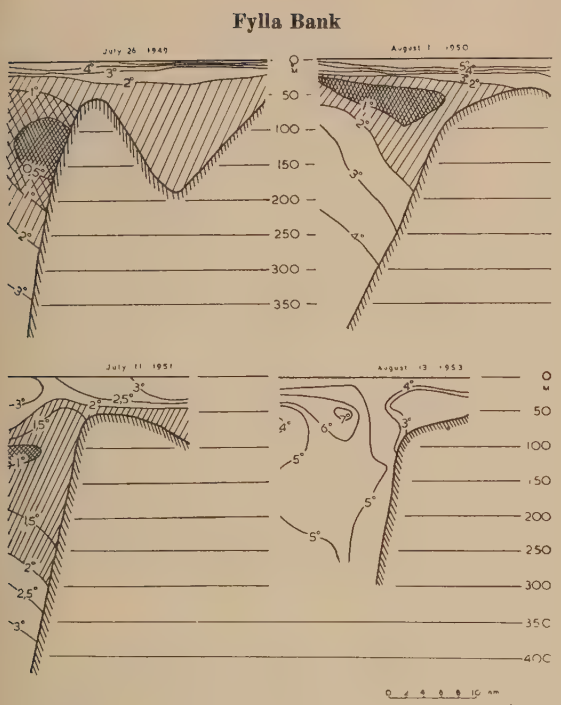


Figure 57. Temperatures in 1949, 1950, 1951 and 1953.

Bank in 1949 was 0.5—1.5° C., in 1950 1—2° C., and in 1953 2—4° C. Observations are lacking for the years 1951 and 1952. On the Fylla Bank the bottom temperature in the same depths was below 1° C. in 1949, in 1950 1—2° C., in 1951 1—1.5° C. In 1953 the bottom temperatures were as high as 4—5° C. In 1953 we found a belt of warm water with a central core of 7° C. a short distance off the western slope of Fylla Bank. In earlier years we have found cold water which has partly covered the slope itself.

The high temperatures in 1953 may perhaps explain other characteristic trends of the Greenland fishery that year. For instance, in the Holsteinsborg Deep in July-August unusually high concentrations of food organisms were observed. An examination of the stomach contents of the cod showed in particular that large amounts of capelin were present, and likewise also sand eels, squids, fish larvae and schizopods. Samples of different organisms were collected, but the material has not yet been worked up. The cod in the Holsteinsborg Deep were of considerably better quality in 1953 than in earlier years. The liver content was above normal and the yield and quality of the oil produced perhaps the best ever attained in Greenland waters by Norwegian fishermen since 1949.

The pelagic fishery in relation to temperature.

The Holsteinsborg Deep is a submarine channel leading in a south-westerly direction from the great complex of fjords in the Holsteinsborg district towards the great deep of the Davis Strait. The submarine channel divides the Store and Lille Hellefiske Bank. From the latter part of July and in August swarms of cod were present in the surface layers above the deep. At times dense shoals were registered on the echo-sounder. The Norwegian vessels started fishing with pelagic long-lines on 24. July. This type of fishing was tried for the first time in 1951. In later years pelagic long-lining has become part of the ordinary fishery off West Greenland. It is therefore of interest to make a closer study of this fishery. According to the fishermen, the cod in the Holsteinsborg Deep were larger than those caught on the shallow parts of Store and Lille Hellefiske Bank at the same time. Trials with long-lines on Store Hellefiske Bank contained such a high percentage of small cod that the fishery was considered unprofitable. The same was the case on the southern banks. In the Holsteinsborg Deep the shoals contained larger fish. The Holsteinsborg cod is also distinguishable by its dark colouration and bluish fins, while the ordinary bank cod has a light brown colour. During the period spent in fishing with pelagic long-lines hydrographic observations were taken continuously with the bathythermograph. The general temperature pattern was almost the same all the time. From 24. July to 10. August the surface temperature varied between 4° and 6°C. The temperature decreased slowly to a depth of 30—55 m. From this point down to a depth of 70—120 m. we found a rapid transition towards colder water masses with temperatures of 2.0—2.5° C.

From 24. July to 10. August the layer of warm surface water increased somewhat in thickness. The border of the warm surface water (4° C.) was on 24. July found at 30 m., on 31. July at 36 m., on 5. August at 40 m. and on 10. August at 55 m. The distance from the surface down to the more homogeneous and colder deep water increased in a similar way. On 24. July the border (2.5° C.) was found at a depth of 72 m. and on 10. August at 120 m. Repeated fishing trials with

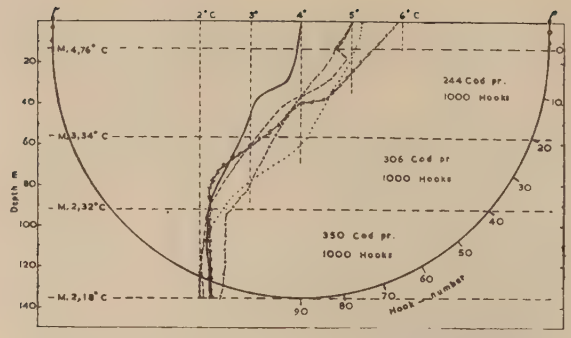


Figure 58. A schematic drawing of a pelagic long-line between two buoys as it probably stands in the sea.

hand-lines seemed to indicate that the cod in the Holsteinsborg Deep were fairly evenly distributed in all depths from the surface down to 150 m. However, the fishery with pelagic lines gave the impression that heavier concentrations of fish were present in certain depths as some parts of the lines would give better catches than others. The question naturally arose whether there could be any connexion between fish occurrence and temperature depth.

During the week 30. July—5. August, controlled catches were made in 4 different settings. The frequency of catch on each single hook of the line was noted, and the mean catches per 1000 hooks in the various depths were computed subsequently.

From Figure 58 it will appear that the surface temperature during the experiment varies between 4 and 6° C. The first hook of the line, nearest the buoy stands in a depth of 13 m. At that depth the average temperature for all days was 4.76° C. The temperature decreases relatively quickly downwards. At 90 m. we found a decided borderline between two temperature regions. The surface layers form a relatively warm ceiling above the underlying layers of water with temperatures between 2—2.5° C. As indicated in the figure, the pelagic long-line fishes through the warm surface layers and some distance down into the cold water masses.

All fish and hooks were counted during the 4 settings with 9540 hooks. The result of the countings is shown in Table 20. From the table it is seen that the fishery gave the smallest yield in the surface layers above 57 m. The temperature in this interval decreased from 4.70° C. at 13 m. to 3.34° C. at 57 m. In the interval between 57 and 92 m. the

Table 20.

Hook numbers	Depth m.	Number of cod per 1000 hooks	
		Total	
1—10....	13—36	248	234
11—20....	36—57	268	235
21—30....	57—76	323	305
31—40....	76—92	324	306
41—50....	92—107	354	334
51—60....	107—119	379	358
61—70....	119—128	385	363
71—80....	128—133	373	352
81—90....	133—136	364	344

catches were somewhat better. The temperature here decreased from 3.34° C. at 57 m. to 2.33° C. at 92 m. The best catches on the line are made between 107 and 128 m. depth, the temperature here being 2.33—2.20° C. On the deepest part of the long-line from 128 to 136 m., the catches again decrease. The temperature here was about 2.18° C.

Size and age of the cod.

The cod caught on pelagic long-lines in the Holsteinsborg Deep show comparatively small variations in size from one day to another during the fishery. The size composition on various dates is shown in Figure 59. In the period 24.—29. July, we found among the usual large fish, about 75 cm. also a relatively large number of smaller cod about 60 cm. in length. The mean size of the cod in this period was 72.97 cm. In the period 31. July—1. August the influx of small cod was somewhat less, and the mean size increased to 73.53 cm. On 10.—11. August a new influx of small-sized cod occurred whereby the mean size of the cod decreased to 71.67 cm.

The length distribution of all cod caught on pelagic long-lines in the Holsteinsborg Deep is shown in Figure 60. The curve has two maxima, one at 60 cm. and one at about 75 cm. Since 1949 the 1942 year-class has been dominant in the long-line catches in Greenland waters, and we find that this is also the case in 1953. Fishery investigations by other countries have proved that the 1947 year-class has been very prominent for a couple of years in the trawl catches taken on the banks and also in the coastal fishery of Greenland. In 1952 the 1947 year-class made up 50.7 % of the Icelandic trawl catches on the Greenland banks, while the same year-class in the same year was only present to a small extent in the Norwegian long-line

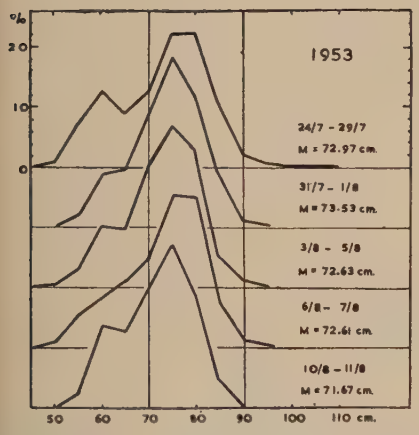


Figure 59. Length distribution of cod at various dates.

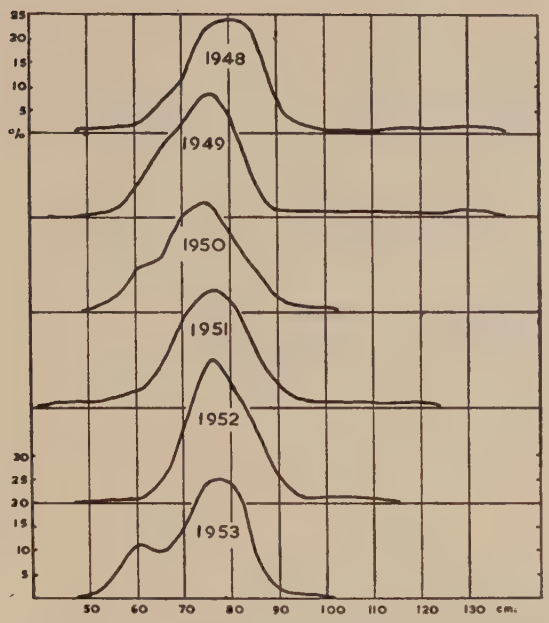


Figure 61. West Greenland, length distribution of line-caught cod on off-shore banks; Norwegian vessels.

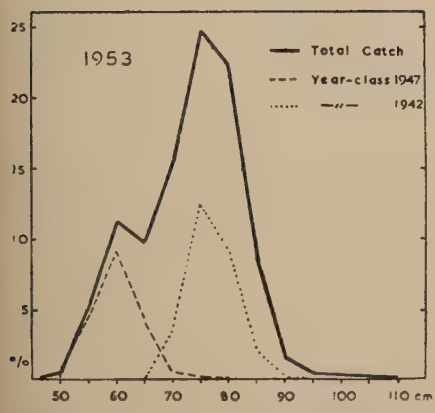


Figure 60. Total length distribution, and length of 1942 and 1947 year-classes of cod caught on pelagic long-lines in the Holsteinsborg Deep in 1953.

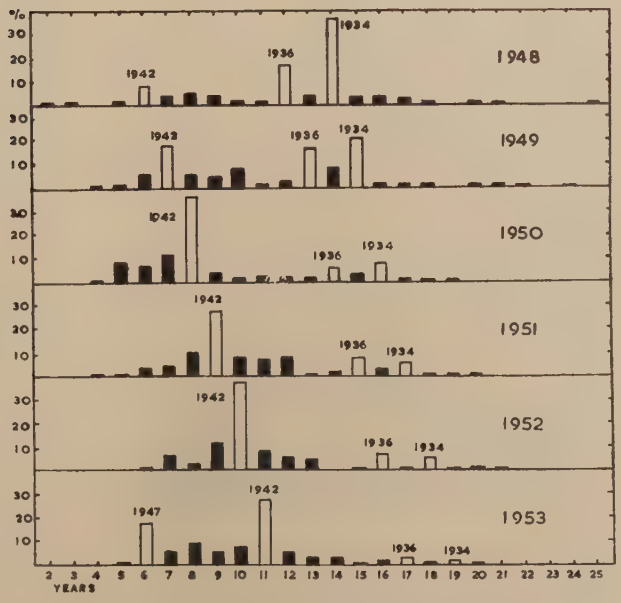


Figure 62. West Greenland, age composition of line-caught cod on off-shore banks; Norwegian vessels.

catches. Not until the 1953 season did this year-class enter the fishery with long-lines. The cod of the 1947-class are now 6 years old. In Figure 60 are shown the length distributions of the 1947 year-class and the 1942 year-class as represented in the long-line samples from 1953. The mean size of cod belonging to the 1947 year-class is 59.9 cm. Cod belonging to the 1942 year-class have a mean length of 76.9 cm. It is further seen from Figure 60 that the sizes of two year-classes correspond with the two maxima in the length distribution of all fish caught.

The line-caught cod belonging to the 1942 year-class had the following mean lengths in the last few years:—

Year	Age	Length, cm.
1948.....	6	66.5
1949.....	7	—
1950.....	8	73.0
1951.....	9	73.7
1952.....	10	75.7
1953.....	11	76.9

The table indicates that the 1942 year-class, during the last three years, has had a mean yearly increment of only 1.3 cm. The new strong year-class of 1947 appearing in the long-line catches has in 1953 a mean size of only 59.9 cm. Apparently the six-year-old fish born in 1947 are 6.6 cm. smaller than the six-year-old fish born in 1942. This fact seems to confirm the supposition that the growth conditions on the West Greenland banks have been unsatisfactory for several years.

The age-distribution of the line-caught cod in 1953 is shown in Table 21. In addition to the material from the Holsteinsborg Deep, otoliths were collected on Fylla Bank, where a single sample was collected on 13. August.

The 1947 year-class is poorly represented on Fylla Bank compared with the Holsteinsborg Deep. The 1942 year-class however, is present in both localities in the same quantity (about 29 %). The mean age in 1952 for all fish in the Holsteinsborg Deep was 11.1 years, in 1953, 10.0 years. The mean size of the cod in the same locality is in 1952 75.99 cm. and in 1953, 72.58 cm. The reason for this decrease in mean age and size is the increasing occurrence of the relatively small cod born in 1947.

In Figure 61 is shown the length distribution of cod caught on long-lines in the different years from 1948 to 1953. The long-line,

Table 21.

Age	Holsteinsborg Deep %	Fylla Bank %	Mean %
5	0.9	1.0	0.9
6	19.1	5.1	18.3
7	5.3	4.6	5.3
8	9.9	7.8	9.9
9	5.4	3.6	5.3
10	9.4	6.1	9.3
11	28.5	29.0	28.6
12	5.7	4.6	5.6
13	4.3	7.1	4.5
14	3.4	9.7	3.8
15	0.6	1.0	0.7
16	1.5	3.6	1.7
17	2.8	7.1	3.1
18	1.7	2.5	1.7
19	0.9	5.1	1.2
20	0.1	2.5	0.2

whether on bottom or pelagic, seems to be a gear with relatively great selective ability in regard to fish size. Usually the mean length of the cod lies between 70 and 85 cm. In the years 1948—52 between 69 and 87 % of the cod had a mean length of 70 to 85 cm. In 1953 71.2 % of the catch were of this size.

In Figure 62 is illustrated the age distribution of cod caught on long-lines in all years from 1948 to 1953. In the Norwegian long-line fishery particularly three year-classes have hitherto given great yields, viz., those from 1934, 1936 and 1942. Very rich year-classes seem to keep their strength over a great number of years. The 1934 and 1936 year-classes have thus given fairly good yields as late as in 1952 when the fish were 18 and 16 years old respectively. However, in 1953 they seem to have lost their strength.

The 1942 year-class began to appear in the long-line catches in 1948 when the fish was 6 years old, and it has since, for five years, been the most important year-class in the long-line fishery. In 1953 it still seems to have a relatively great strength, and it will probably also next year have a decisive influence on the yields of the Norwegian long-line fishery— not only on account of the numerical strength, but also because of the size and weight of the fish belonging to that year-class.

The 1947 year-class which began to appear in the catches in 1953 will probably increase in numerical strength next year. However, owing to the small size of the fish, the 1947 year-class will hardly become very important to the Norwegian long-line fishery, at least not in the next few years.

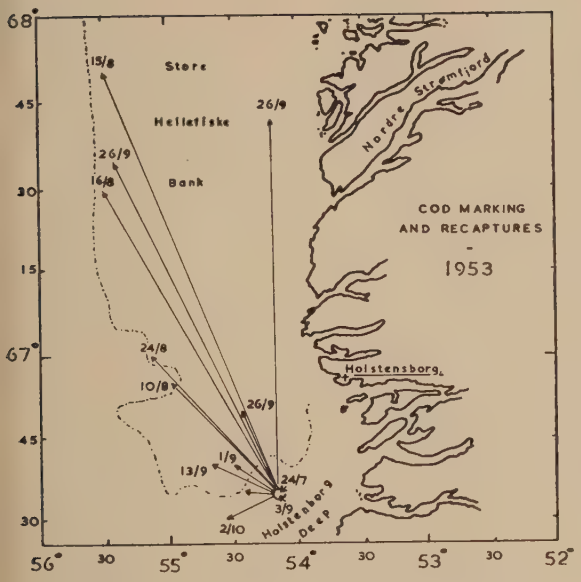


Figure 63. Cod marking and recaptures, 1953.

Tagging of cod in the Holsteinsborg Deep.

In earlier reports it has been mentioned that the pelagic cod in the Holsteinsborg Deep differed from the ordinary bank cod by its dark-coloured back and bluish fins. The present author has also mentioned that the shoals of cod observed in the Deep were possibly fish which had migrated from the fjord districts further east. It is of great interest to solve the question. In 1953 tagging was therefore carried out in the Holsteinsborg Deep. A total of 512 cod were marked with large yellow plastic marks fastened with silver wire to the gill cover.

Till the end of the year 1953 altogether 13 recaptures have been reported. The recaptures were made 0—70 days after the date of tagging (Figure 63). Four fish were recaptured in the tagging locality. All the others were recaptured on Store Hellefiske Bank. The recaptures show a clear tendency for the fish to migrate northwards when leaving the Holsteinsborg Deep. It is perhaps not improbable that the pelagic shoals in the Holsteinsborg Deep may be cod from Store Hellefiske Bank undertaking a feeding migration southwards in summer and returning to the bank later in autumn. The large numbers in the pelagic shoals of fish belonging to the 1947 year-class also indicate that this may be the case. According to Paul Hansen the 1947 year-class was particularly rich on Store Hellefiske Bank in 1952, while its numerical strength decreased to the south. Our own samples showed a similar trend in 1953. In the Holsteinsborg Deep 19.1 % of the catch consisted of the 1947 year-class, while Fylla Bank further south only yielded 5.1 %.

It will be of interest in the coming years to study more closely the pelagic shoals of cod. According to the fishermen similar pelagic concentrations of cod were also found in the submarine channels between the more southerly banks.

Birger Rasmussen.

The English Trawl Fishery at Cape Farewell.

Only small-scale cover of Greenland cod landings was obtained from the Humber markets during 1953. A total of 776 cod were measured, 494 of which were otolithed. The percentage length and age composition is given below and shows the continued importance of the 1945 year-class in the commercial catches from this general area.

Compared with the figures for 1952 catches at Cape Farewell were lower than during the previous years and fishing tended to spread outside the immediate area of the Cape, northwards to the west coast banks.

Length cm.	30-4	35-9	40-4	45-9	50-4	55-9	60-4	65-9	70-4
No.	1	3	0	14	33	80	101	135	142
%	0·1	0·4	0·0	1·8	4·2	10·3	13·0	17·4	18.3

Length cm.	75-9	80-4	85-9	90-4	95-9	100-4	105-9	110-14	115-19	>120
No.	102	91	32	15	5	1	1	1	0	19
%	13·1	11·7	4·1	1·9	0·4	0·1	0·1	0·1	0·0	2·4

Year-class	1948	47	46	45	44	43	42	41	40
No.	2	65	68	203	52	37	33	12	5
%	0·4	13·2	13·8	41·1	10.5	7·5	6·7	2·4	1·0

Year-class	1939	38	37	36	35	34	33	32	31
No.	1	5	4	2	—	2	—	1	2
%	0·2	1·0	0·8	0·4	—	0·4	—	0·2	0.4

G. C. Trout.

Comité Atlantique.

INTRODUCTION

Les contributions au présent rapport ont été apportées par:

I. Hydrologie.

L. Faure ..... France
R. Letaconnoux ..... France

II. Planeton et Faune.

J. H. Fraser ..... Ecosse
G. F. Barthélémy-Lefèvre ..... France
J. Fleury ..... France

III. Poissons.

Sardine.

J. M. Navaz ..... Espagne
R. Letaconnoux ..... France
J. Fleury ..... France
A. Ramalho et collaborateurs ..... Portugal

LES CONDITIONS DE MILIEU

Hydrologie.

Observations Hydrologiques en Mer Celtique, en Avril et Mai 1953.

Un embarquement à bord du D. O. garde-pêche de la Marine Nationale «Ailette» au cours de la première partie de sa campagne 1953 nous a permis dans la période du 14 Avril au 10 Mai, tout en effectuant les recherches sur la pêche, de faire une étude des conditions hydrologiques en Mer Celtique, Mer d'Irlande et quelques observations en Manche.

Ces dernières, limitées à la région Ile de Wight—Cherbourg nous ont indiqué qu'en Mai le milieu de la Manche était occupé par des eaux ayant une température de 9°.

Pour la Mer Celtique (entrée de la Manche et sud de la Mer d'Irlande) nous avons pu établir les cartes de température et de salinité en surface, à 50 m. et à 100 m.; de plus deux sections ont été faites: Scilly—Ouessant et Scilly—banc Labadie—Donowen head.

Ces divers schémas montrent que l'ensemble de la région étudiée est occupé par des eaux

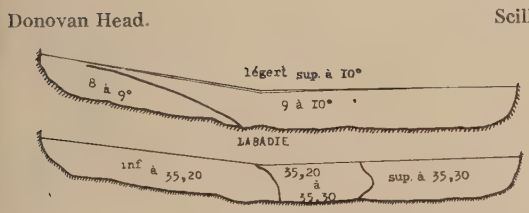


Figure 1. Section Scilly—Donovan Head, 23.—25. Avril.

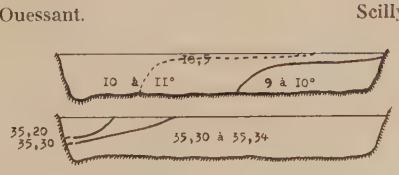


Figure 2. Section Ouessant—Scilly, 6. Mai.

continentales froides d'une température variant entre 8 et 10°. Aux environs des bancs Parson et Shamrock nous rencontrons des eaux plus chaudes dont la température s'élève au dessus de 10° jusqu'en profondeur.

Entre le 18 et le 23 Avril nous avons constaté un réchauffement tout à fait superficiel d'environ 1° sur la côte sud de l'Irlande et les bancs Labadie, Jones et Cockburn; la carte des isothermes de surface correspond à la période du 23 Avril au 6 Mai.

Les cartes des isohalines font ressortir que l'avancée des eaux atlantiques se manifeste plus spécialement dans la région des bancs Parson et Shamrock et le nord de ceux-ci vers Jones bank, et c'est précisément dans cette zone d'eaux chaudes et salées que se tenaient les pêcheries de maquereaux.

L. Faure.

Conditions Hydrologiques en Juin sur les Pêcheries de Germons.

Pendant le mois de Juin 1953, des observations hydrologiques en surface et à 50 m. furent faites à bord du thonier «Tristan» sur les lieux de pêche du germon (*G. alalunga*) situés entre le centre du Golfe de Gascogne et le large du Cap Finisterre.

C'est ainsi qu'au cours de cette sortie des températures variant entre 16 et 18° furent observées en surface en liaison avec des salinités de 35.5 à 35.8 $^0/_{00}$. Plus près de côte les salinités notées n'étaient plus que de l'ordre de 34.5 $^0/_{00}$. (Figure 4).

En fin Juin la situation hydrologique était donc caractérisée par la présence habituelle de la nappe chaude à 18° au centre du Golfe de Gascogne et du lobe transgressif, également

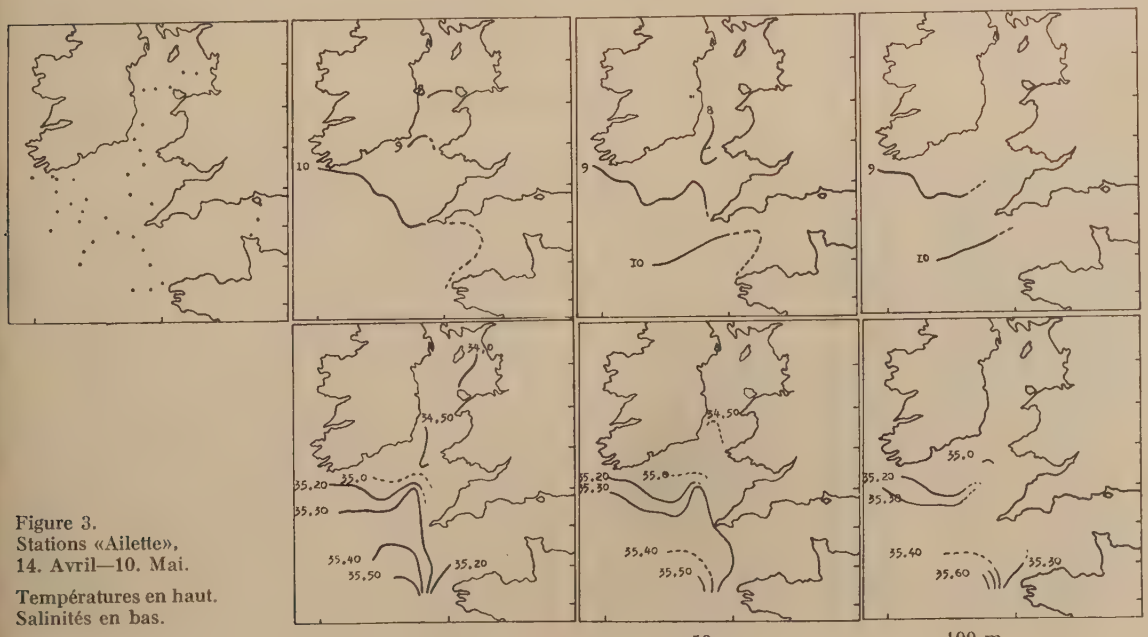


Figure 3.
Stations «Ailette»,
14. Avril—10. Mai.

Températures en haut.
Salinités en bas.

Figure 4. Salinités observées en surface.

Figure 5. Températures observées en surface.
• Position des stations.

à 18°, situé dans l'ouest du Cap Finisterre. Cependant, par rapport à 1952, on constatait que les eaux à 16° s'étendaient jusqu'à une latitude plus basse, sauf à l'extrémité ouest du secteur étudié où un phénomène inverse se produisait.

Il en résulte qu'au sud de la latitude du Cap Finisterre les eaux avaient en surface une température égale ou supérieure à celle de l'an passé tandis qu'au nord elles étaient par contre plus froides de près d'un degré.

D'autre part, la masse des eaux ayant en profondeur une température supérieure à 14° était cette année moins épaisse qu'en 1952.

En ce qui concerne les salinités, leur distribution, en surface et à 50 m., était comparable à celle de Juin 1952.

R. Letaconnoux.

Plancton et Faune.

Scottish Plankton Investigations during 1953.

Four lines of plankton samples taken by H. M. S. "Challenger" west of the entrance to the English Channel were examined at Aberdeen. These were:

15—19 April	49°30′N.	3°30′W.	to	47°16′N.	17°52′W.
25—28 May	47°50′N.	17°40′W.	to	49°28′N.	5°52′W.
18—23 June	50°08′N.	4°25′W.	to	46°46′N.	19°37′W.
30 July— 1 August	48°15′N.	11°59′W.	to	Falmouth Bay.	

Those collections made over deep water (i.e. west of about 8°W.) contained plankton of particular interest as they form a link between the collections made off the coast of the Iberian Peninsula (Fleury, Ann. Biol., IX, p. 83) and the Scottish collections made further north. Many oceanic species such as *Eudoxoides spiralis* and *Bassia bassensis* were present throughout the period, although there was a gradual change of fauna. The Thaliacea present in April and May were *Salpa fusiformis, Dolioletta gegenbauri* and *Ihlea asymmetrica* with the very rare species *Ritteriella picteti.* By June these had largely been replaced by *Iasis zonaria, Doliolum nationalis* and the rare *D. mülleri.* The large diatom *Ethmodiscus gazellae,* 1.8 mm. in diameter, was found in both May and June. Several species of Sapphirina and large numbers of radiolaria appeared in May and June, but by July these had largely been replaced over deep water by a rich diatom flora of *Nitzschia delicatissima, Thalassiothrix longissima* and *Rhizosolenia alata.* On the shelf the oceanic species were lacking but an abun-

dance of small copepods, mainly *Oithona*, and plutei developed there.

Scottish investigations in the Atlantic in 1953 have been mainly confined to the north of the area covered by this committee, but during August the southern limits of this work extended into the area between the west coast of Scotland and Rockall. The results of these investigations are given under the North-Western Area. They show that the penetration of the «Lusitanian» fauna exceeded previous years in 1953, and this is probably associated with an unusually large amount of Mediterranean influence. Several species known to have a distribution in the Mediterranean, but not previously recorded from the north temperate Atlantic, were found this year; notably the salp *Cyclosalpa virgula*, the doliolid *D. mülleri* and the diatom *Ethmodiscus gazellae*.

J. H. Fraser.

Résultats de diverses Campagnes.

A. L'«Ailette», Mer Celtique—Mer d'Irlande, 10 Avril — 10 Mai 1953.

I. Note sur le Plancton.

Le plancton capturé à l'entrée occidentale de la Manche et au sud de l'Irlande jusqu'au 48° de Lat. N. illustre les différents types d'eaux reconnus (voir «Observations Hydrologiques en Mer Celtique, en Avril et Mai 1953» — L. Faure).

Les eaux à *Sagitta setosa* sont plaquées au sud des côtes anglaises et irlandaises.

Les eaux à *Sagitta elegans*, associée à de nombreux crustacés parmi lesquels *Calanus finmarchicus, Candacia armata, Nyctiphanes couchii* et de très nombreuses zoés et mégalopes de crabes, occupent la plus grande partie de l'aire étudiée. Ce plancton est très riche. *Oikopleura dioica* est abondamment réparti. Les Ptéropodes appartenant surtout au genre *Limacina* avec les espèces *L. helicinoïdes* et *L. trochiformis* pullulent à une station de l'entrée de la Manche (149°37′ N.—8°17′ W.). Les espèces: *Acartia discaudata, Anomalocera Patersoni, Calanus finmarchicus, Candacia armata, Centropages typicus, Oithona helgolandica* sont parmi les Copépodes les plus largement distribués.

L'influence océanique est marquée par la présence de *Sagitta serratodentata*.

J. Fleury.

II. Oeufs et Larves de Poissons.

L'examen des pêches de plancton effectuées par M. Louis Faure, chef de laboratoire à Roscoff, au cours d'une mission à bord du dragueur océanographique «Ailette» de la Marine Nationale, nous a permis de constater la présence de nombreux œufs et larves de poissons. Nous fournissons dans le Tableau 1 ci-dessous les données qui ont été recueillies et que nous compléterons ultérieurement.

G. F. Barthélémy-Lefèvre.

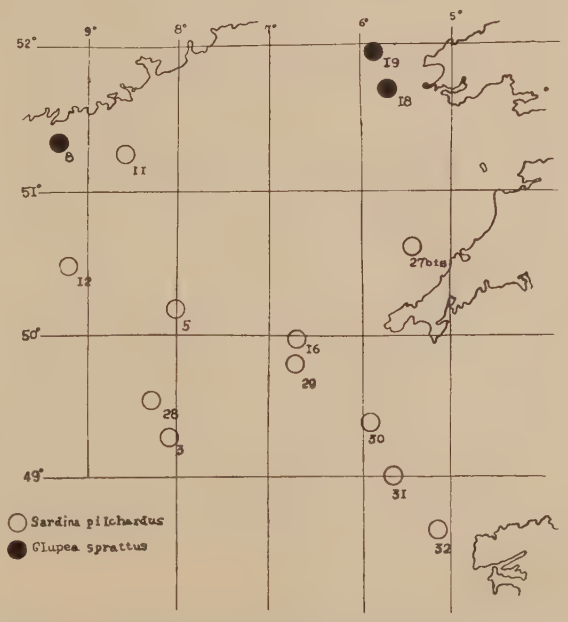


Figure 6. Répartition des oeufs et des larves de Clupeidae. Campagne de «l'Ailette» 1953.

B. «Président Théodore Tissier», Brest à Terre-Neuve, Août 1952.

L'une des croisières effectuées en Atlantique par le «Président Théodore Tissier» en 1952 sur le trajet de Brest à Terre-Neuve a révélé la présence de *Germo alalunga* au 49° de Lat. Nord dans le secteur compris entre le 12° et le 20° de Long. Ouest.

Dans ce secteur le caractère océanique des eaux salées et chaudes est accusé par la présence des espèces planctoniques suivantes: *S. serratodentata, Doliolum gegenbauri, Salpa fusiformis, Thalia democratica, Muggia atlantica, Euchoeta hebes.*

Tableau 1.

Stn.	Ech.	Date	Heure	Lat. N.	Long W.	T° 0 m.	Sal.	Sonde	Espèce	Oeufs Nombre	Larves Nombre	Larves Dimension mm.
		Avril										
3	2	15	1030	49°23′	8°04′	9°60	35.52	130	*Sardina pilchardus*	71	—	
									Trigla sp.	1	—	
									Maurolicodidae	1	—	
									Scomber scombrus	2	—	
5	3	15	1930	50°10′	8°20′	9°70	35.34	130	*Sardina pilchardus*	2	—	
									Scomber scombrus	2	—	
9	4	16	1400	51°26′	10°16′	9°60	35.19	105	*Onos* sp.	2	—	
									O. cimbrius	—	—	8
									Gadus pollachius	—	—	10.5
									Ammodytes lanceolatus	—	—	12
10	5	18	0000	51°20′	9°18′	9°	35.17	67	*Callionymus lyra*	9	3	
									Gadidae	—	6	3.5 à 7
									Gadus virens	—	1	8
									Pleuronectes microcephalus	—	3	
									Clupea sprattus	—	5	
11	6	23	2100	51°16′	8°34′	10°20	35.16	101	*Scomber scombrus*	25	—	
									Sardina pilchardus	—	3	
12	7	24	0230	50°30′	9°10′	10°20	35.28	120	*Scomber scombrus*	50	—	
									Sardina pilchardus	—	3	
									Gadidae	—	1	4.5
									Argentina sphyraena	—	1	
13	8	24	0630	50°	9°28′	10°20	35.37	130	*Scomber scombrus*	3	—	
13 bis	9	24	—	50°26′	8°12′	—	—	—	*Scomber scombrus*	3	—	
14	10	24	1845	50°38′	8°00′	10°20	35.21	100	*Onos* sp.	5	—	
									Gadus, sp.	20	—	
									Scomber scombrus	20	—	
16	11	25	1145	49°59′	6°45′	9°90	35.37	106	*Sardina pilchardus*	42	9	
									Pleuronectes microcephalus	—	1	5.5
									Solea vulgaris	—	1	4
									Solea variegata	—	1	(5.3)
									Gasterosteidae	—	1	
18	13	25	2200	51°43′	5°48′	9°20	35.33	115	*Clupea sprattus*	—	9	12—19
19	14	25	2400	51°58′	5°56′	9°40	34.52	95	*Clupea sprattus*	—	11	12—19
20	15	26	0200	52°12′	6°04′	8°50	34.38	78	*Gadus* sp.	1	—	
		Mai										
27	16	3	1200	50°55′	6°13′	9°90	35.34	70	*Gadus* sp.	7	—	
									Scomber scombrus	6	—	
27 bis	17	3	1630	50°37′	5°27′	9°50	—	—	*Sardina pilchardus*	46	—	
									Gadus sp.	1	—	
									Scomber scombrus	39	—	
									Gadus pollachius	—	1	7
28	18	4	2000	49°37′	8°17′	10°80	35.35	130	*Scomber scombrus*	17	—	
									Sardina pilchardus	—	2	
29	19	5	2030	49°50′	6°46′	11°40	35.34	90	*Scomber scombrus*	1	—	
									Sardina pilchardus	100	—	
									Blennius pholis	—	—	7
30	20	5	2330	49°25′	5°54′	10°60	35.28	110	*Solea variegata*	1	—	
									Scomber scombrus	6	—	
									Gadus	4	—	
									Sardina pilchardus	225	4	9—10.5
31	21	6	0230	49°00′	5°36′	10°80	35.22	107	*Solea variegata*	2	—	
									Scomber scombrus	21	—	
									Sardina pilchardus	180	3	6—6.5—11
32	22	6	0530	48°39′	5°12′	10°80	35.17	110	*Sardina pilchardus*	120	—	
									Ammodytes lanceolatus	—	1	17

Les éléments dominants du plancton sont constitués à l'ouest du 15° de Long. Ouest par les Salpes (*Thalia democratica, Salpa fusiformis*) et à l'est de ce même méridien par des *Siphonophores* (Muggiae) qui voisinent avec *Doliolum gegenbauri* et *Sagitta serratodentata*.

La corrélation entre l'abondance des thons et des *S. serratodentata* s'affirme particulièrement à la station 228 (L.: 48°44′ Lat. N. Gr.: 11°52′ Long. W.).

La nappe d'eau trangressive a également transporté toute une faune de crustacés et particulièrement de Copépodes pélagiques tempérés *Candacia armata* Boeck, *Centropages typicus* Kröyer, *Centropages Bradyi* Wheeler, *Euchoeta hebes* Giesbr., *Rhincalanus nasutus* Giesbr., parfois fréquents.

Un lobe d'eaux nettement plus froides se situe à la limite ouest de la capture des thons (Stn. 237—L.: 49°04′ Lat. N. Gr.: 22°14′ Long. W.). Il se caractérise par l'absence des espèces mentionnées dans les zones avoisinantes et par une pullulation d'*Acartia discaudata* Giesbr. et d'*Oithona helgolandica* Claus et de très nombreux Radiolaires de petite taille donnant au plancton l'aspect d'une purée verte.

C. Thoniers, Petite Sole et Grande Sole, Juillet/Août 1953.

Du 29 Juillet au 8 Août 1953, sur les lieux de pêche du thon, la faune planctonique est abondante et variée au voisinage du 49° de Lat. N. et du 9° de Long. W.

Les Copépodes appartiennent à des formes océaniques, pour la plupart tempérées ou chaudes:

Arietellus setosus, Giesbr., *Calocalanus plumosus* Claus,
Clausocalanus arcuicornis Dana,
Clytemnestra rostrata Brady, *Centropages Bradyi* Wheeler,
Centropages typicus Kröyer, *Euchoeta marina* Prest,
Euchirella messinensis Claus, *Mecynocera clausi* Thomp.,
Paracalanus parvus Claus, *Phoenna spinifera* Claus,
Pleuromamma abdominalis Lub., *Pleuromamma borealis* Dahl,
Pleuromamma xiphias Giesbr., *Scolecithrix Bradyi* Giesbr.

Les Amphipodes, (à l'exception de *Brachyscelus crusculum* sp. Bate) appartiennent à des espèces cosmopolites surtout nordiques:

Euthemisto bispinosa Boeck, *Hyperia galba* Mont.,
Paraphronima gracilis Claus, *Parathemisto oblivia* Kröyer,
Phronima sedentaria Forsk.

La nature des eaux, océaniques chaudes et salées, est accusée par la présence de Siphonophores et de Méduses, puis du Ptéropode *Diacria trispinosa* et surtout par la présence fréquente des espèces indicatrices suivantes:

Sagitta serratodentata Krohn, *Iasis zonaria* Pallas et *Doliolum gegenbauri* Uljanin.

J. Fleury.

LES POISSONS

CLUPÉIDÉS

Sardine.

La Sardine du Centre du Golfe de Gascogne en 1953.

De Mai à Octobre 1953 des observations régulières sur les pêcheries de sardines situées entre l'Ile d'Yeu et l'Ile d'Oléron furent effectuées par le laboratoire de La Rochelle.

Ces observations montrèrent la présence de sardines répondant à trois types différents et ayant les caractéristiques suivantes:

	Taille modale mm.	Moy.Vert.	Taille à L_1 mm.
1. Gr. I_0 de type armoricain:	145	52.48	121
	125 à 150	52.23	105 à 94
2. Gr. I_1 de type aquitanien:	150	52.19	87
3. Gr. 0_c et I_c de type cantabrique:	125	51.84	—
	165	51.89	92

Tableau 2.

A. Tailles observées.

Date	Mai 7	Mai 26	Juin 15	Juille 2	Août 5	Août 26		Sept. 4	Octobre 9	
mm.										
120....	2	2	—	—	—	—	—	5	—	—
5....	7	6	—	—	—	3	—	39	—	—
130....	5	21	—	5	—	7	—	34	—	—
5....	17	42	4	14	—	2	—	18	1	—
140....	23	21	33	58	—	—	—	4	4	—
5....	29	6	42	19	6	—	9	—	6	—
150....	15	2	20	3	44	—	41	—	—	5
5....	2	—	—	1	30	—	30	—	—	13
160....	—	—	1	—	18	—	5	—	—	23
5....	—	—	—	—	1	—	3	—	—	26
170....	—	—	—	—	1	—	—	—	—	14
5....	—	—	—	—	—	—	—	—	—	5
180....	—	—	—	—	—	—	—	—	—	2
5....	—	—	—	—	—	—	—	—	—	1
N.....	47	242	100	85	100	12	88	76	16	130

B. Tailles à L_1.

mm.										
70....	—	—	—	—	1	—	—	—	—	—
5....	—	—	—	—	2	—	6	—	—	8
80....	—	—	—	5	5	—	23	—	4	—
5....	—	1	—	10	9	—	24	—	4	12
90....	—	2	1	19	14	—	24	—	8	12
5....	4	7	3	31	36	—	11	—	—	28
100....	4	21	16	25	26	—	9	—	—	16
5....	2	31	41	5	6	—	2	—	—	8
110....	9	29	28	5	1	—	—	—	—	—
5....	13	8	9	—	—	—	1	—	—	—
120....	14	1	1	—	—	—	—	—	—	—
5....	32	—	1	—	—	—	—	—	—	—
130....	9	—	—	—	—	—	—	—	—	—
5....	9	—	—	—	—	—	—	—	—	—
140....	4	—	—	—	—	—	—	—	—	—
Moyenne	121	105	106	94	94	—	87	—	86	92

C. Moyenne vertébrale.

50....	—	—	—	—	—	—	—	1	—	1
51....	3	10	7	4	2	2	13	19	—	10
52....	21	58	59	60	66	7	47	47	7	18
53....	20	31	25	21	32	3	26	9	6	8
54....	3	1	2	—	—	—	2	—	—	—
	52.48	52.23	52.23	52.20	52.30	52.08	52.19	51.84	52.46	51.89

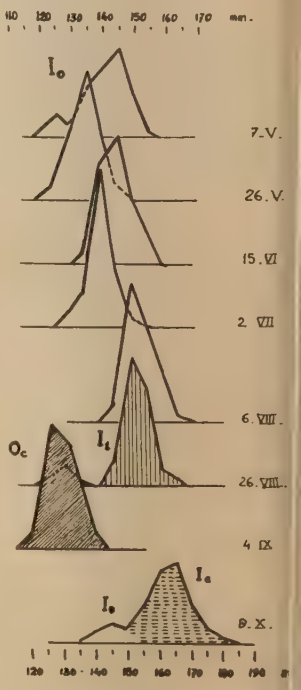


Figure 7.

Les sardines de type armoricain s'observèrent seules sur la pêcherie de Mai à Août, période pendant laquelle leur taille modale passa de 125 à 150 mm.

En fin Août cette population disparut pour faire place à quelques sardines de type aquitanien mais celles-ci semblèrent peu nombreuses et furent rapidement remplacées, dès le début de Septembre, par d'autres sardines se rattachant au type cantabrique et représentées par des individus des groupes 0 et I dont les tailles modales étaient respectivement de 125 et 165 mm.

Ces observations montrent que, comme au cours des dernières années, la présence de sardines de type cantabrique remplaçant presque complètement celles de type aquitanien caractérise le peuplement sardinier de cette région au cours de l'année 1953.

R. Letaconnoux.

Côte Basque.

La crise des sardines continue sur les côtes nord et nord-ouest d'Espagne avec des caractères encore plus aigus, ce qui empêche l'étude méthodique de l'espèce.

Nous avons pu observer seulement quatre échantillons (chacun de cent poissons) pendant l'année 1952 et un pendant l'année 1953, pêchés au filet tournant. Tous proviennent du fond du Golfe de Gascogne, région de Saint-Sébastien, excepté le troisième, pêché plus à l'ouest à la hauteur de Zarauz.

Tableau 3. Sardine de la Côte Basque.

A. Taille et Poids.

Dates	1952 22/II	1952 11/III	1952 23/V	1952 20/XI	1953 10/II	1952 22/II	1952 11/III	1952 23/V	1952 20/XI	1953 10/II	Total
Taille, mm.	Nombre					Poids (g.)					
100	3	—	—	—	—	5.5	—	—	—	—	5.5
105	13	—	—	—	1	6.6	—	—	—	8.0	7.3
110	46	—	—	—	15	7.3	8.0	—	—	9.6	8.3
115	23	2	—	—	33	8.1	8.0	—	—	10.6	8.9
120	9	2	—	—	26	9.7	9.5	—	—	11.8	10.3
125	6	15	—	1	13	11.6	13.0	—	12.3	13.8	12.6
130	—	16	—	6	9	—	14.2	—	15.3	15.5	15.0
135	—	15	—	9	1	—	15.7	—	17.5	17.0	16.6
140	—	19	—	7	1	—	17.6	—	20.0	18.5	18.7
145	—	13	16	5	1	—	19.8	21.3	23.0	20.0	21.1
150	—	11	16	18	—	—	23.1	26.0	25.5	—	24.8
155	—	4	12	18	—	—	26.2	27.8	28.2	—	27.7
160	—	1	24	22	—	—	29.0	29.0	31.3	—	29.7
165	—	2	20	10	—	—	32.0	33.9	33.3	—	33.6
170	—	—	12	4	—	—	—	36.9	37.5	—	37.2
Moyenne	110.9	137.4	157.3	151.9	119.0						

B. Caractères sexuels.

	1952 22/II	1952 11/III	1952 23/V	1952 20/XI
Nombre ♂	—	16	30	41
Taille moy., mm	—	142	153	151
Nombre ♀	—	38	70	59
Taille moy., mm	—	145	159	152
Indéterminé	100	46	—	—
Taille moy., totale	110.9	137.4	157.3	151.9
Maturité sexuelle				
Stade I, %	100	56	20	18
Stade II	—	24	54	46
Stade III	—	15	24	24
Stade IV	—	5	2	12
St. moyenne	—	1.69	2.08	2.30
Engraissement viscéral.				
Degré I	100	—	—	—
Degré II	—	48	14	44
Degré III	—	52	86	47
Degré IV	—	—	—	9
Moyenne	—	2.5	2.8	2.6

C. Formule vertébrale.

Nombre de vertèbres	1952 22/II	1952 11/III	1952 23/V	1952 20/XI	1953 10/II	Total
50	2	—	—	—	2	4
51	18	20	16	22	19	95
52	50	49	50	54	50	253
53	28	28	33	24	26	139
54	2	3	1	—	3	9
Moyenne	52.10	52.14	52.19	52.02	52.09	52.10

Année	1944	1948	1949	1951	1952—53
Moyenne	51.94	51.96	51.96	51.93	52.10

Taille et poids.

La longueur totale, mesurée au millimètre, a été ramenée au demi-centimètre le plus proche. Les poids moyens du Tableau 3 A se rapportent aux classes de tailles ainsi établies.

Les deux premiers échantillons, celui de 1952 et celui de 1953, rassemblent des sardines d'un an dont la taille moyenne respective est de 11.0 et 11.9 cm. Les autres lots dont la taille moyenne est de 13.7, 15.7 et 15.2 se rapportent à des sardines âgées d'un an et demi et de deux ans.

La présence en hiver des petites sardines à taille moyenne de 10 cm., est un fait souvent constaté dans cette région.

Sexualité et engraissement.

Le nombre des femelles dépasse celui des mâles; le pourcentage respectif est de 65.8 % de femelles et de 34.2 % de mâles. La taille moyenne des mâles est un peu moindre que celle des femelles: ils atteignent respectivement 148 et 152 cm.

Les quelques données réunies ne permettent pas de tirer des conclusions sur la maturité sexuelle de la sardine à l'étape considérée, car malheureusement la pauvreté du matériel risquerait de fausser les faits.

L'engraissement est conforme à la règle générale; offrant un rapport inverse avec le degré de maturité des gonades.

Formule vertébrale.

La formule vertébrale qu'offrent les lots étudiés, est assez homogène bien que la moyenne qui donne 52.10 soit un peu plus élevée que celle qui a été obtenue dans les observations antérieures, comme on peut le constater dans le Tableau 3 C.

José M. Navaz.

La Sardine de la Côte du Portugal en 1953.

Pêche.

La production totale a été à peu près la même qu'en 1950, 1951 et 1952, c'est-à-dire 80,000 tonnes environ. Le port de Leixões (près de Porto) continua à la tête des autres ports de pêche avec plus de la moitié du total de la sardine débarquée. La pêche a été plus productive pendant les mois de Août à Décembre, période pendant laquelle 80 % du total annuel a été débarqué (90 % à Leixões).

Matériel recueilli.

Les observations ont été effectuées à:— 1) Leixões, sur 44 échantillons hebdomadaires de 200 sardines, comprenant en tout 8,785 poissons (observateur, J. Machado Cruz, au Laboratoire de Zoologie Maritime de l'Université de Porto); 2) Lisbonne, sur 42 échantillons analogues comprenant 8,135 sardines (observateurs, A. M. Ramalho, J. Santos Pinto, Ivone Barraca, Pedro Graça, à l'Institut de Biologie Maritime); 3) Portimão, sur 228 échantillons de 100 sardines recueillis tous les jours de pêche de Mars à Décembre (observateur, J. Luis, à l'usine de conserves de sardine de M. Antonio Feu).

Taille.

La longueur a été mesurée du bout du museau à la fourche de la nageoire caudale (longueur **A** dans les tableaux et figures) au demi-centimètre le plus proche; cette dimension correspond à 90 % de la longueur totale, caudale comprise, désignée par longueur **B.** La Figure 8 montre, sous forme de graphiques,

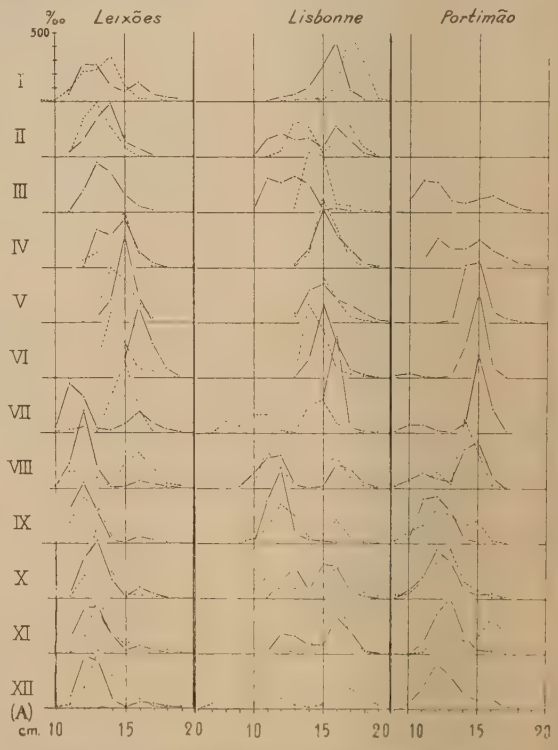


Figure 8. Fréquence des tailles, par mois, en %.
..... 1952 .—.—. 1953

Tableau 4.

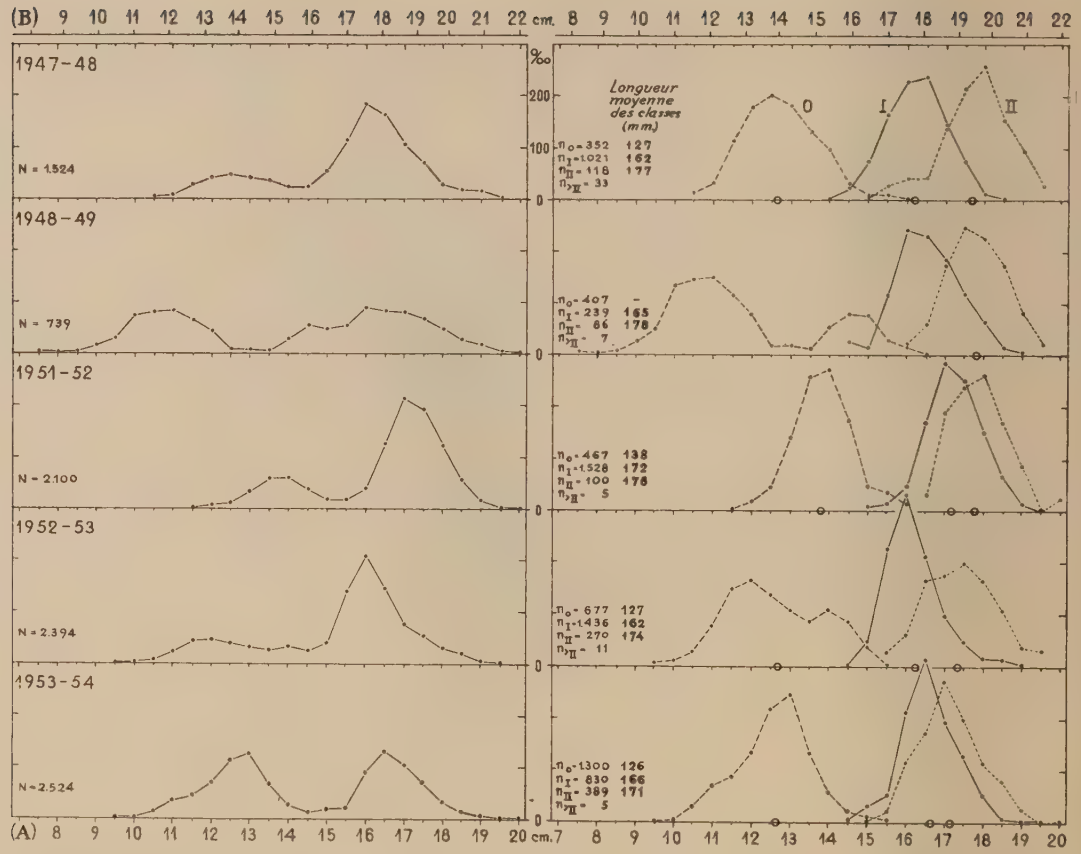
Taille par classes de 1 cm. de la longueur (A), par mois, et en ‰. 1953.

Longueur: cm. (A)	(B)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
a) Leixões.													
10.2	11.4	—	—	—	—	—	—	30	8	—	—	—	—
11.2	12.5	55	25	2	—	—	—	366	181	236	39	107	98
12.2	13.6	269	110	155	5	—	—	256	569	433	291	333	394
13.2	14.7	261	283	353	281	26	—	25	141	230	409	333	349
14.2	15.8	111	393	298	225	165	—	4	5	28	122	126	66
15.2	16.9	88	102	128	359	601	141	62	9	2	14	19	7
16.2	18.0	134	72	47	104	195	514	149	41	51	81	59	46
17.2	19.1	52	15	17	24	13	249	75	36	20	39	22	30
18.2	20.3	24	—	—	2	—	84	29	9	—	5	1	9
19.2	21.4	6	—	—	—	—	12	4	1	—	—	—	1
N.	Échantillons	4	2	2	4	4	4	4	4	4	4	4	4
	Sardines	800	400	400	800	800	800	800	800	800	800	800	800
b) Lisbonne.													
9.2	10.3	—	—	—	—	—	—	—	12	—	—	—	—
10.2	11.4	—	8	26	—	—	—	—	105	2	—	—	—
11.2	12.5	5	128	246	—	—	—	—	219	302	4	7	—
12.2	13.6	31	173	207	—	—	—	—	239	539	127	150	—
13.2	14.7	54	113	269	20	60	1	—	24	89	226	138	—
14.2	15.8	101	125	203	138	240	138	—	2	35	71	71	—
15.2	16.9	263	85	23	420	292	522	245	17	29	255	73	—
16.2	18.0	435	216	22	244	186	256	700	179	4	243	274	—
17.2	19.1	91	122	4	132	134	68	49	154	—	55	160	—
18.2	20.3	20	25	—	38	70	13	5	38	—	14	25	—
19.2	21.4	—	5	—	8	15	2	1	11	—	5	2	—
20.2	22.2	—	—	—	—	3	—	—	—	—	—	—	—
N.	Échantillons	2	3	4	3	4	5	4	5	4	4	4	—
	Sardines	394	600	665	500	776	1,000	800	1,000	800	800	800	—
c) Portimão.													
9.2	10.3	—	—	—	—	—	15	11	8	—	3	—	—
10.2	11.4	—	—	88	—	—	38	64	57	40	57	4	27
11.2	12.5	—	—	220	60	—	2	68	103	316	158	85	144
12.2	13.6	—	—	211	202	1	—	17	72	345	355	296	318
13.2	14.7	—	—	89	140	8	5	4	53	239	280	404	243
14.2	15.8	—	—	70	140	411	242	72	281	45	82	141	103
15.2	16.9	—	—	99	200	448	609	573	344	15	27	31	67
16.2	18.0	—	—	111	122	93	84	182	80	—	30	28	78
17.2	19.1	—	—	80	87	34	5	9	2	—	8	11	17
18.2	20.3	—	—	24	37	5	—	—	—	—	—	—	3
19.2	21.4	—	—	8	12	+	—	—	—	—	—	—	—
N.	Échantillons	—	—	12	22	30	18	31	31	23	29	22	10
	Sardines	—	—	1,200	2,200	3,000	1,800	3,100	3,100	2,300	2,900	2,200	1,000

les observations groupées par mois et par classes de taille de 1 cm. (exprimées en millièmes du nombre de sardines) et, en plus, celles obtenues l'année précédente (1952).

En règle la classe 0, avec une taille inférieure à 13 (14.5) cm., apparaît pour la première fois dans le produit de la pêche vers la fin du mois de Juin ou le commencement du mois de Juillet et acquiert très vite une prédominance très marquée dans les quantités débarquées pendant les mois suivants. Passée à la classe I vers la fin de Février, elle constitue alors la plus grande partie du produit de la pêche, jusqu'à l'arrivée de la nouvelle classe 0 en Juin-Juillet. Ce schéma comporte, toutefois, des variations selon les ports et les saisons de pêche.

La Figure 9 montre, sous forme de graphiques, les résultats des observations faites à Lisbonne pendant les cinq hivers de 1947—48, 1948—49, 1951—52, 1952—53 et 1953—54 (mois de Novembre à Février) sur la composition des classes d'âge 0, I et II au point de vue de taille. L'âge a été déterminé par les écailles d'une partie seulement des sardines des échantillons étudiés, mais on a fait le



Total des échantillons. Figure 9. Par classes d'âge.

calcul pour trouver les nombres correspondants aux totaux des diverses tailles. Dans la moitié gauche de la figure les graphiques représentent les fréquences des tailles observées, par classes de demicentimètre et en millièmes des totaux de chaque hiver. On voit qu'en 1948—49 et 1953—54, bien que la classe 0 soit présente par un grand nombre d'exemplaires, elle ne constitue qu'un peu plus de 50 % des sardines observées; pour les autres hivers, au contraire, la classe 0 n'est pas aussi abondante que la classe I.

Dans la moitié droite de la Figure 9 les graphiques représentent, en millièmes du total de chaque classe, les fréquences des tailles respectives et les moyennes pour chaque classe.

Classe 0. L'amplitude observée des tailles de cette classe en hiver peut être très considérable, comme c'est le cas en 1948—49, avec 7.5 (8.0) cm. de taille minima et 16.5 (18.0) cm. de maxima. Il se peut qu'une partie des plus grandes tailles attribuées à cette classe soit due à ce que l'anneau d'hiver ne s'est pas formé l'année précédente dans les écailles de sardines appartenant à la génération respective; cette supposition s'appuie aussi sur d'autres genres d'observations dont nous ne nous occuperons pas en ce moment. Nous nous inclinons donc à considérer la taille de 15 (16.5) cm. comme représentant pratiquement, pendant l'hiver, la limite supérieure de la taille de la classe 0 dans la région de Lisbonne. La mode du polygone de fréquences en 1947—48 est de 12.5 (14) cm. et la moyenne de 12.7 cm.; en 1948—49 la distribution est très irrégulière et bi-modale; en 1951—52 la mode se place à 13.5—14.0 (15.0—15.5) cm. et la moyenne atteint la valeur exceptionnelle de 13.8 (15.2) cm.; l'hiver

suivant, malgré le caractère bi-modal du polygone de fréquence, la moyenne est devenue presque la même que celle de 1947—48, c'est-à-dire, 12.7 (14.0) cm., le même fait se constatant en 1953—54.

Classe I. Pour ce qui a trait à la classe I les différences entre les valeurs observées pendant les cinq hivers ne sont pas aussi grandes. Le mode se place en règle entre 16.0 et 16.5 (17.5 et 18.0) cm.; cependant, en 1951—52 hiver pendant lequel la classe 0 avait aussi des tailles plus grandes, la mode de la classe I est placée à 17.0 et 17.5 (18.5 et 19.0) cm. Cet hiver excepté, pendant lequel la moyenne a été de 17.2 (19.0) cm., les moyennes ont varié entre 16.2 (18.0) et 16.6 (18.5) cm. seulement.

Classe II. Cette classe est toujours représentée par un très petit nombre d'exemplaires (5 à 15 %). Le mode des polygones de fréquences varie entre 17 et 18 (18.5 et 20) cm., selon les hivers, et les moyennes entre 17.1 et 17.8 (19 et 20) cm. La classe III apparaît très rarement.

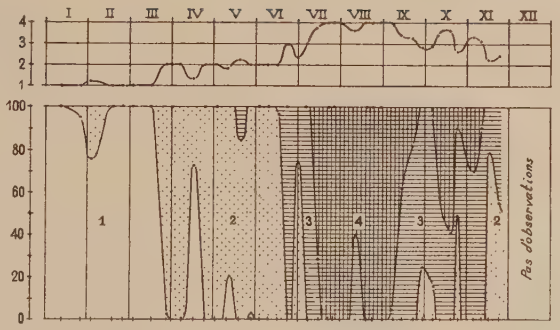


Figure 10. Lisbonne—1953.
Adiposité, ♀: Moyennes et pourcentages.

Adiposité.

La Figure 10 montre, sous la forme de deux graphiques, le résultat des observations effectuées sur les échantillons étudiés à Lisbonne. On ne reproduit que les données sur les femelles, parceque les mâles, sauf un ou autre détail insignifiant, se comportent à ce sujet d'une façon identique. La variation de l'adiposité est exprimée, selon l'échelle usuelle, par les stades 1 à 4.

Tableau 5.

Maturité sexuelle des femelles. 1953.

En ‰ par mois.

Stade	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
a) Leixões.												
1.....	4	—	—	—	34	13	703	891	710	300	139	13
2.....	137	25	38	90	604	516	287	109	290	672	794	731
3.....	270	167	514	372	140	113	5	—	—	23	60	201
4.....	433	635	410	415	165	222	5	—	—	5	5	48
5.....	152	170	38	110	57	131	—	—	—	—	2	7
6.....	4	3	—	2	—	—	—	—	—	—	—	—
7.....	—	—	—	11	—	5	—	—	—	—	—	—
N. sardines...	460	318	239	465	401	382	407	488	435	396	402	398
Moyenne.....	3.6	4.0	3.4	3.6	2.6	3.0	1.3	1.1	1.3	1.7	1.9	2.3
b) Lisbonne.												
1.....	11	—	172	9	15	306	—	429	1,000	496	231	—
2.....	—	34	107	73	392	172	815	544	—	447	473	—
3.....	62	241	337	314	232	200	116	27	—	32	216	—
4.....	673	608	294	564	283	292	64	—	—	25	80	—
5.....	237	117	87	36	43	26	5	—	—	—	—	—
6.....	17	—	3	—	—	—	—	—	—	—	—	—
7.....	—	—	—	4	35	4	—	—	—	—	—	—
N. sardines...	177	290	309	220	396	500	406	338	401	405	402	—
Moyenne.....	4.2	3.8	3.0	3.6	3.1	2.6	2.3	1.6	1.0	1.6	2.1	—

Maturité sexuelle. (Tableau 5).

Selon les observations faites à Leixões et à Lisbonne, le cycle chez les femelles est presque identique à celui de l'année 1952. On continue a constater le nombre très petit de femelles au stade VI, c'est-à-dire, avec des ovaires aux œufs transparents, ce qui renforce la supposition que l'aire de ponte est située au-delà de l'aire de la pêche commerciale.

Tableau 6.

Fréquence du nombre de vertèbres. 1953.

En ‰ et par mois.

a) Leixões.

Mois	No. échan.	49	50	51	52	53	N	M	± Fl.M.
I	4	—	46	601	343	10	800	51.32	± 0.07
II	2	—	60	496	421	23	385	51.41	± 0.11
III	2	—	42	570	375	13	400	51.36	± 0.10
IV	4	1	40	586	354	18[2])	800	51.35	± 0.07
V	4	3	53	616	321	7	800	51.28	± 0.07
VI	4	—	62	615	308	15	800	51.28	± 0.07
VII	4	—	80	600	313	7	800	51.25	± 0.07
VIII	4	—	59	619	312	10	800	51.27	± 0.07
IX	4	—	61	554	368	17	800	51.34	± 0.07
X	4	1	63	602	319	14[2])	800	51.29	± 0.07
XI	4	[1])	49	605	334	11	800	51.30	± 0.07
XII	4	—	61	561	359	19	800	51.34	± 0.07
Ann.	44	+	57	590	339	13	8,785	51.31	± 0.02

[1]) 1 sardine avec 48. [2]) 1 sardine avec 54.

b) Lisbonne

No. échan.	49	50	51	52	53	N	M	± Fl.M.
2	—	48	670	279	3	294	51.24	± 0.10
3	—	60	638	295	7	420	51.25	± 0.09
4	—	67	650	280	3	400	51.22	± 0.09
3	—	43	614	333	10	300	51.31	± 0.11
4	—	75	628	290	7	400	51.23	± 0.10
5	2	74	676	244	4	500	51.17	± 0.08
4	—	57	635	300	8	400	51.26	± 0.10
5	—	80	630	282	8	500	51.22	± 0.09
4	—	87	638	268	7	400	51.19	± 0.10
4	—	87	650	260	3	400	51.17	± 0.10
4	—	73	660	260	7	400	51.20	± 0.10
1	—	80	670	250	—	100	51.17	± 0.19
43	+	70	645	278	6	4,514	51.22	± 0.03

c) Portimão.

Mois	No. échan.	50	51	52	53	N	M	± Fl.M.
VII	2	65	655	280	—	200	51.22	± 0.13
VIII	5	80	622	292	6	500	51.22	± 0.09
XI	1	30	780	180	10	100	51.17	± 0.16
Ann.	8	70	650	275	5	800	51.22	± 0.07

Moyenne vertébrale. (Tableau 6).

Les observations ont porté sur 8,785 sardines de Leixões, 4,514 de Lisbonne et 800 de Portimão. A Leixões les moyennes mensuelles varièrent entre 51.25 et 51.41 et la moyenne annuelle a été de 51.31, presque identique à celle de 1952 qui fut de 51.33. Machado Cruz, dans un travail récent (Not. e Estud. Inst. Biol. Mar., No. 7, Mars 1954) a étudié au point de vue statistique la variation de la moyenne vertébrale de tous les échantillons par la méthode de l'analyse de la variance de Fisher modifiée par Snedecor (test F) et conclut pour la non-homogénéité du matériel observé. Ceci l'a amené à supposer que dans l'aire de pêche au voisinage de Leixões il y a des mouvements migratoires occasionnels de sardines provenant soit du nord (moyenne en général plus élevée), soit du sud (moyenne plus basse) se mélangeant avec une population locale plus stable dans la région.

A Lisbonne la moyenne annuelle a été la même que l'année précédente, c'est-à-dire, 51.22, et les moyennes mensuelles ont varié entre 51.17 et 51.31. A Portimão, les résultats de l'observations de 8 échantillons, sont analogues à ceux de Lisbonne.

A. de M. Ramalho et collaborateurs.

North Sea.

INTRODUCTION

The number of contributions for 1953 covering the whole or substantial parts of the North Sea is very satisfactory, and the writer is glad to have this opportunity to thank all those who have helped to produce this report. Information about shellfish and herring will be found in the appropriate sections.

Contributions for 1953 have been received from: —

Denmark:

K. P. Andersen
A. J. C. Jensen
J. Smed
H. Thomsen
E. Ursin

England:

J. G. Cattley
J. A. Gulland

Germany:

H. J. Aurich
Hj. Bohl
G. Dietrich
G. Hempel
A. Kotthaus
E. Ziegelmeier

Scotland:

R. E. Craig
J. H. Fraser
R. Johnston
R. Jones
J. M. Lamont
W. Main
B. B. Rae
K. M. Rae
J. B. Tait
E. Wilson

A. Environment.

Detailed analysis of data for 1902—48 now provides a measure of the homogeneity of the water column in the southern half of the North Sea, both as a basis for general work and for comparison with future years. From November to April these waters appear to be homogeneous to about 1 °C. (or less) over most of the area, and from September to April they are largely homogeneous to 0.10 $^{0}/_{00}$. The distributions of the exceptions are clearly shown in a series of 24 charts.

Homogeneity and stratification are looked at from another point of view in a report dealing with thermal-stratification along the main axes of the North Sea during August, 1953. The data are related to the corresponding data concerning tidal streams, and typical distributions are distinguished which are expected to be of importance in interpreting physical, chemical and biological phenomena in the North Sea.

Continued analysis of long-term temperature trends reveals that the surface temperatures of the waters off the east coast of Scotland averaged as much as 1 °C. above the means for the period 1876—1915. With the possible exception of 1945 (when there were few observations) this is the highest anomaly on record for this area. Similarly high temperatures were recorded in 1953 at the Lightvessel "Vyl".

These systematic temperature observations are confirmed by the evidence from salinity analyses and drift-bottle records, both of which point to unusually strong Atlantic influence in the north during the early months of the year. Although this probably declined a little during the summer, there was a further increase in intensity during the autumn.

Relatively detailed observations off the north coast of Scotland in the spring were again

consistent with some flow of western coastal water through the channel to the south of Fair Isle, although high salinities recorded to the east of Fair Isle must be judged as probably coming from the north. In the charts illustrating this survey, a new method of defining "coastal influence" is used, and described in a separate note.

Records of oxygen and inorganic phosphate values for 1953 can now be compared with those records published in *Annales Biologiques* 9, for 1952. There is little difference to which significance can be attached as yet and, similarly, the series of temperature, salinity, oxygen and phosphate determinations for the waters of the "Bløden" Ground serve principally to confirm the impressions recently gained of the conditions there. The two sets of oxygen and phosphate data are, however, complementary and are beginning to provide the "standards" which are essential to a fuller understanding of the annual changes and their significance for the fisheries.

Plankton evidence from both the Scottish research vessel surveys and the Continuous Plankton Records agrees with the hydrographical data in demonstrating 1953 as a year of unusual oceanic influence. The evidence was to be found at least as far south as Lat. 56°N., and a number of forms were recorded, either as rarities or in unusual quantities, both in the North Sea and its north-western approaches. It is not easy to achieve a condensed summary of widespread plankton evidence over a term of years, but a very simplified table of some of the major fluctuations over the period 1920—53 is now given for the first time, as a framework to which can be related the more detailed evidence of the annual reports.

More precise information, continuing that previously reported for the plankton found between Flamborough Head and the Dogger Bank, also provides some review of the variations recorded during the period since 1933.

B. Fish.

Young Fish and Fish Eggs: The increase and extension of spawning of the pilchard, sprat, anchovy, mackerel and horse mackerel was again evident in the southern North Sea during 1953. To a lesser extent, this is thought to have applied also to the sole. While the spawning of plaice was somewhat delayed this year, its abundance seems to have exceeded that recorded for any year since 1936. By contrast, the abundance of cod fry over the same area shows little change from 1952.

Haddock: According to research vessel data, the 1952 and 1951 broods amounted to over 90% of haddock captured, although only the 1951 brood attained the minimum commercial landing size. While total landings and catch per unit (British steam trawlers) decreased during the first half of 1953, there was an appreciable increase later. The 1953 brood promises to be only "poor" to "average".

Whiting: Both landings and catch per unit (British) showed some decrease from 1952.

Plaice: The plaice mortality rates, as calculated from English trawler landings, have continued at well below the pre-war levels, some 60—70% of the fish surviving each year. For all that, the rich 1947 year-class, as judged by Danish and German investigations, is now very scarce and those following it seem to have been relatively poor until 1952. The 1951 year-class seems to have been extremely poor over a wide area.

C. E. Lucas.

ENVIRONMENT

Hydrography.

Monthly Anomalies of the Surface Temperature in an Area off the Eastern Coast of Scotland in 1953.

In *Annales Biologiques*, **9**, monthly anomalies of the surface temperature in the area F (56°—60°N., 0°—3°W., see Figure 1) were published for the period 1876—1952, the grand monthly means for 1°-squares over the period 1876—1915 being used as standard.

Table 1. Monthly Anomalies (△°C.) and Numbers (n) of Observations of the Surface Temperature in the Area F (see Figure 1) in 1953.

Jan.		Feb.		March		April		May	
△	n	△	n	△	n	△	n	△	n
0.5	44	0.5	37	1.0	35	0.9	64	1.0	43

June		July		Aug.		Sept.	
△	n	△	n	△	n	△	n
0.8	77	0.8	67	0.8	81	0.6	79

Oct.		Nov.		Dec.		Average
△	n	△	n	△	n	of △-values
1.2	62	1.2	65	2.1	23	1.0

Table 1 gives the temperature anomalies for the months of 1953. It is seen that all the monthly anomalies are positive and none of them less than 0.5°C. Averaged over the year the anomaly is 1.0°C. During the years investigated, i.e., 1876—1939, 1945—1953, this value has been reached once before only, viz., in 1945; for that year, however, a dozen observations only, distributed over two months, were available. In the two preceding years, 1951 and 1952, the anomalies were only 0.1° and 0.3°C., respectively.

JENS SMED.

On the Homogeneity of the Water Column in the Southern North Sea.

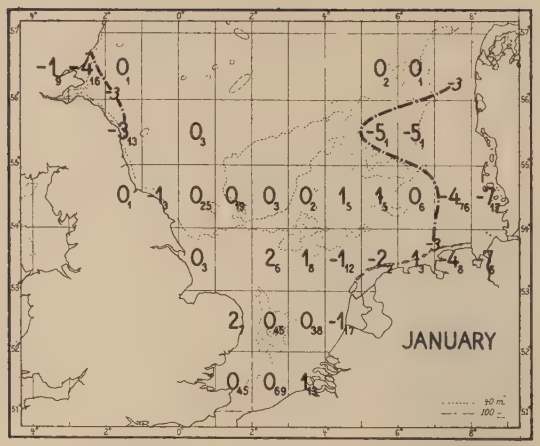
As it would be of some interest to know to which extent surface observations were representative for the whole water column in

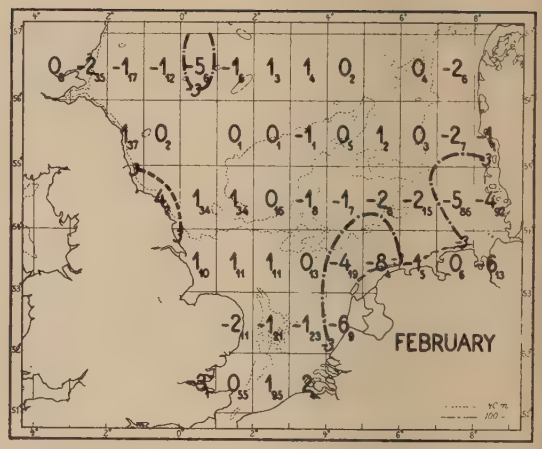
Figure 1. Location of area.

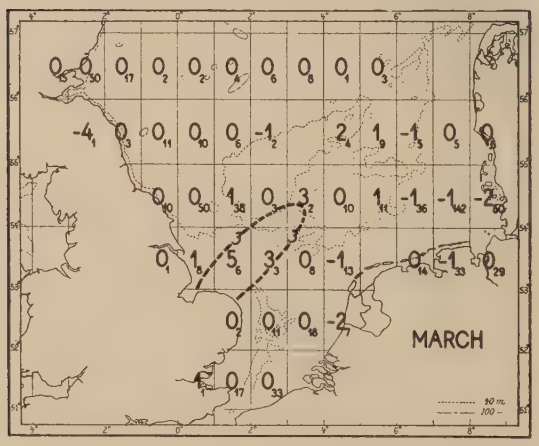
the southern North Sea the question was taken up in the Service Hydrographique of the Council at the instigation of the Chairman of the Hydrographical Committee, Prof. H. U. SVERDRUP. Some information on this point was already available[1]). The aim of the present work is to supplement this information by giving details on the extent in each month of the year of the areas where the water column is homogeneous.

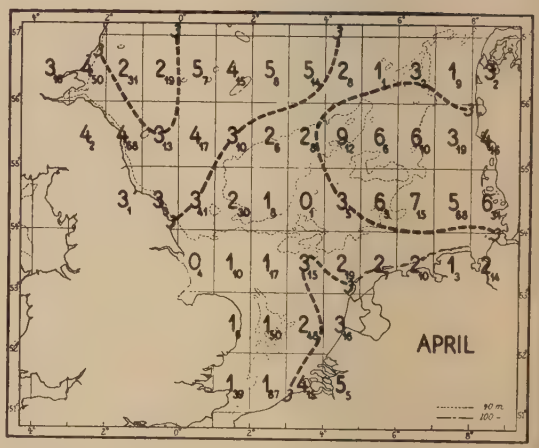
The data contained in the hydrographical card-index of the Council, covering the years 1902—1948, served as a basis for the investigation. For each station the difference in temperature and salinity between surface and bottom was read off. These differences were then averaged for each month and for each 1°-square. The results are given in Figures 2 i—xii (temperature) and 3 i—xii (salinity). As an index to the average difference for each 1°-square is given the number of stations on which the average is based. Curves are drawn—with some smoothing—through points where the temperature difference, surface minus bottom is 1°, 0.3°, —0.3°, and —1° C., and through points where the salinity difference,

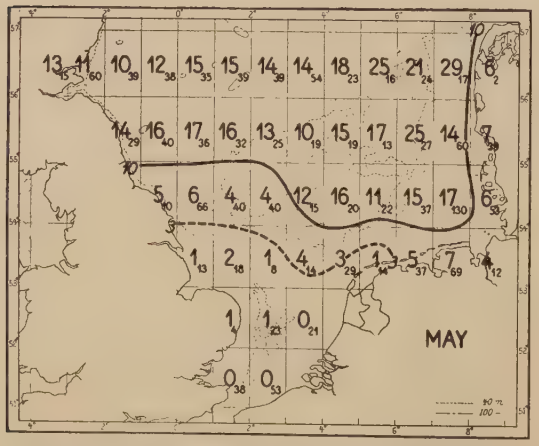
[1]) See for instance G. DIETRICH: "Die natürlichen Regionen von Nord- und Ostsee auf hydrographischer Grundlage." (Kieler Meeresforsch., **7**, pp. 35—69. 1950).











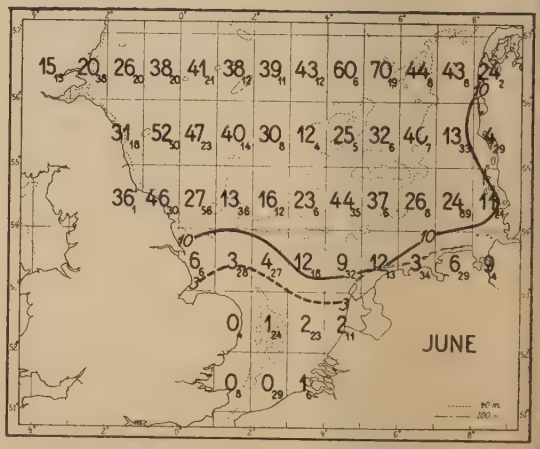
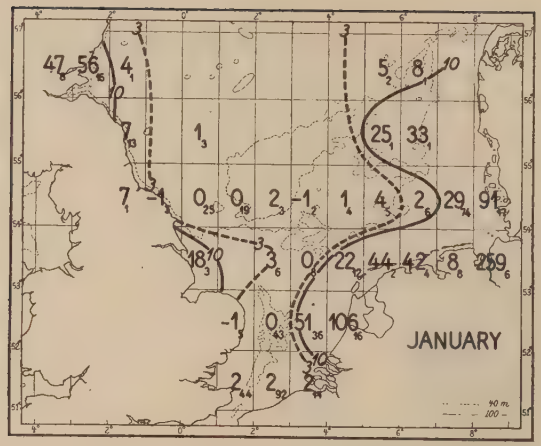
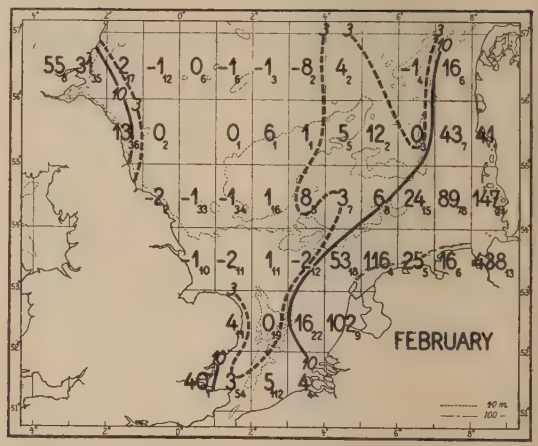
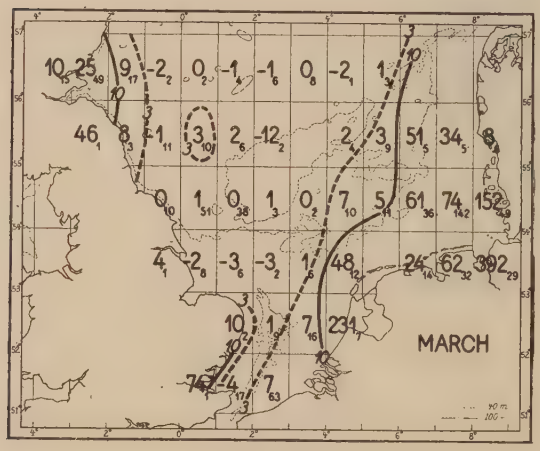


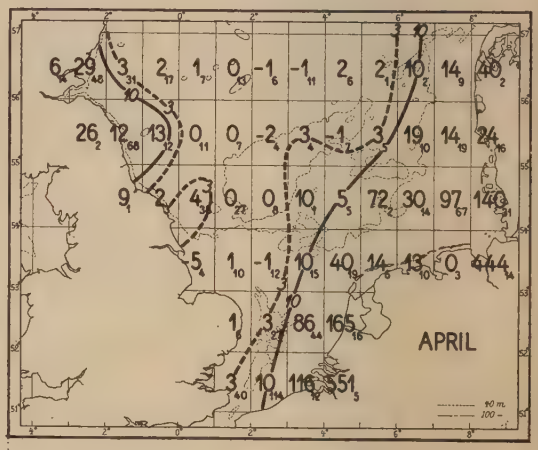
Figure 2i—vi. Temperature differences surface-bottom (unit 0.1°C.) for January (. . . June). The recorded values are averages for 1°-squares; indices indicate number of stations. The curves are drawn on the basis of the recorded values with some smoothing.

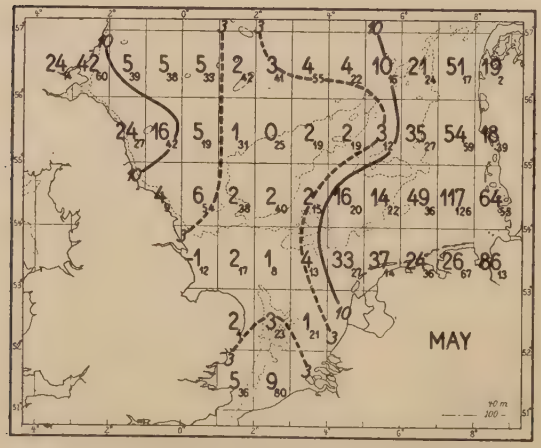
Figure 2vii—xii. Temperature differences surface-bottom (unit 0.1° C.) for July (. . . December). The recorded values are averages for 1°-squares; indices indicate number of stations. The curves are drawn on the basis of the recorded values with some smoothing.











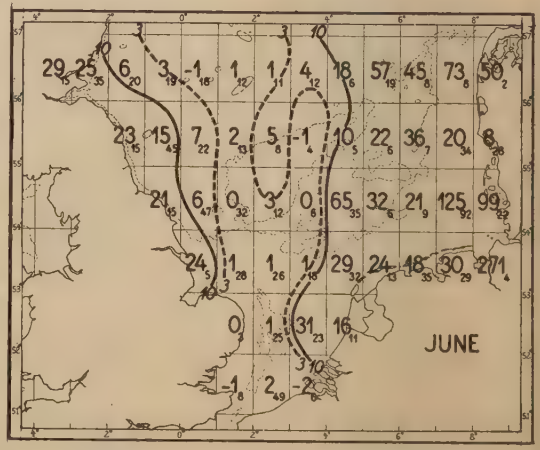


Figure 3i—vi. Salinity differences bottom-surface (unit 0.01 ‰) for January (. . . June). The recorded values are averages for 1°-squares; indices indicate number of stations. The curves are drawn on the basis of the recorded values with some smoothing.

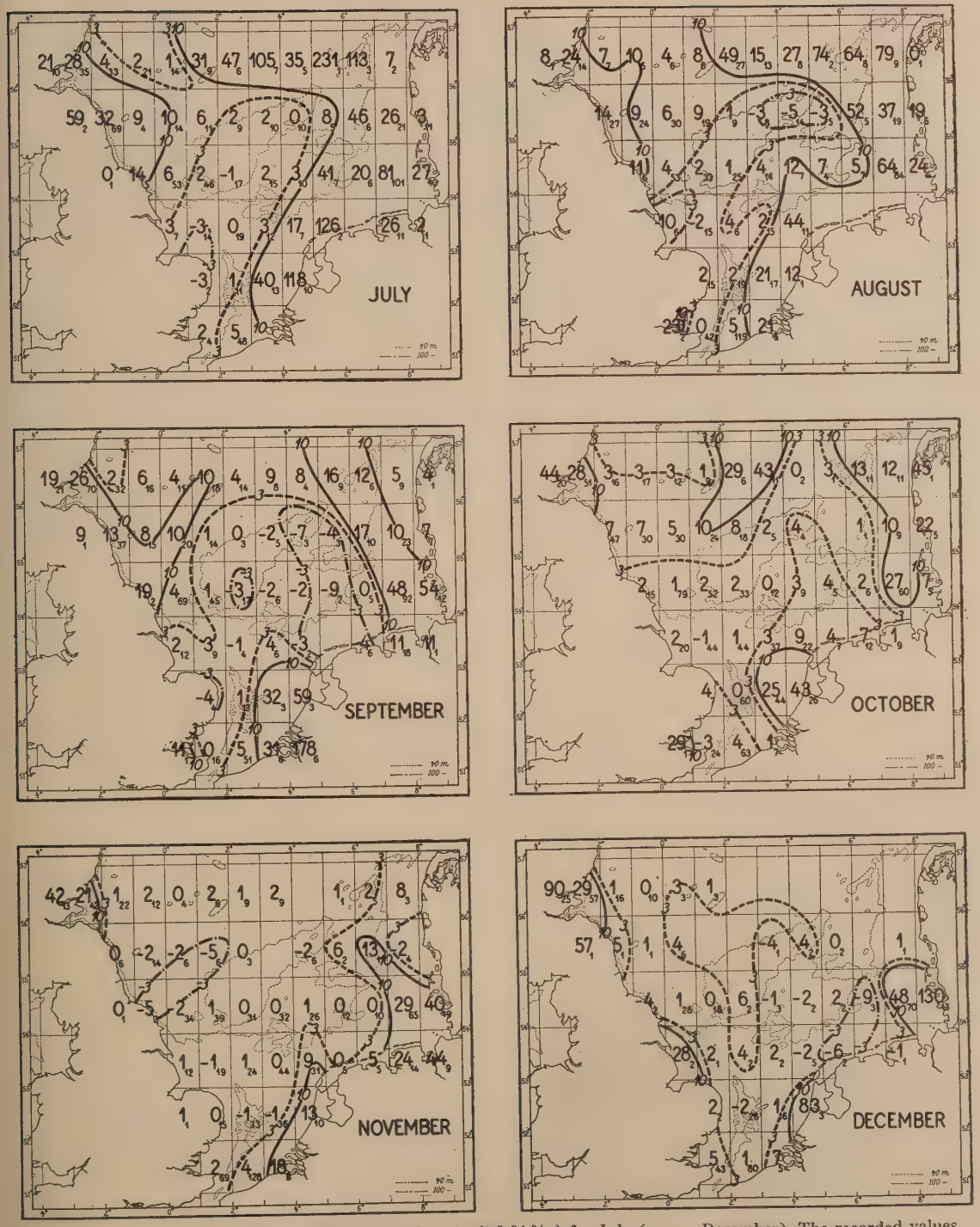


Figure 3vii—xii. Salinity differences bottom-surface (unit 0.01 °/₀₀) for July (. . . December). The recorded values are averages for 1°-squares; indices indicate number of stations. The curves are drawn on the basis of the recorded values with some smoothing.

bottom minus surface, is 0.10, 0.03, —0.03, and —0.10‰.

It is seen from the figures that during the months January to April the water column in the whole region, and during November-December in practically the whole region, is homogeneous in temperatures within 1 °C. With exception of small, though in April somewhat greater areas, this is true even within 0.3 ° C. In the months May to August the homogeneity is mainly limited to the southernmost part of the region considered, whereas in the months September and October homogeneity is also found in the eastern part and in an area near the Scottish coast.

With regard to salinity the water column is homogeneous to 0.10‰ in the months November to April except in the eastern part and in minor coastal areas in the western part. In these months the water column in the main part of the region is even homogeneous to 0.03‰. In the months May to August the homogeneity is limited more or less to the central part of the region. Again, in September and October the water column is homogeneous to 0.10‰ in nearly the whole region, whereas homogeneity to 0.03‰ is only found in a much smaller area.

Jens Smed.

Figure 4. Course of temperature sections in Figure 5 with oceanographical stations 1—70, carried out by the surveying research vessel "Gauss" in August 1953 and distribution of maximum velocities (cm./sec.) of tidal streams in the North Sea at spring tide.

Thermal Stratification of the North Sea in August 1953.

On a longitudinal section and a cross section through the North Sea, the geographical positions of which are to be seen from Figure 4, Figure 5 shows the vertical distribution of temperature. Observations made at short intervals with reversible thermometers, supplemented by registrations of the vertical distribution of temperature with thermo couples, give an insight into the micro-structure of thermal stratification. This shows a close relationship to the turbulence of the tidal streams, which is dealt with elsewhere (G. Dietrich: Einfluss der Gezeitenstromturbulenz auf die hydrographische "Schichtung der Nordsee", Arch. f. Meteorol., Geophys., Bioklimat. 1954). This is especially true for the sub-stratum which is separated from the homothermal surface layer by the summer discontinuity layer at a depth of approximately 25 m. According to the effectiveness of the turbulence of the tidal streams, one can distinguish four typical regions of the thermal stratification in the North Sea: —

1. The sub-stratum is thermally stratified. The effects of the turbulence of the tidal stream remain limited to a thin mixing layer close to the bottom. Conditions of stratification of the remaining water column resemble those of the open ocean. An example of this is found in the northern North Sea, north of station 36.
2. The sub-stratum is homothermal and also homohaline, and therefore homogeneous. An example of these conditions is found in the central North Sea north of station 10 on the north-south section and between stations 24—60 on the west-east section.
3. The effect of the turbulence of the tidal stream increases with the approach to the shallower waters of the Dogger Bank,

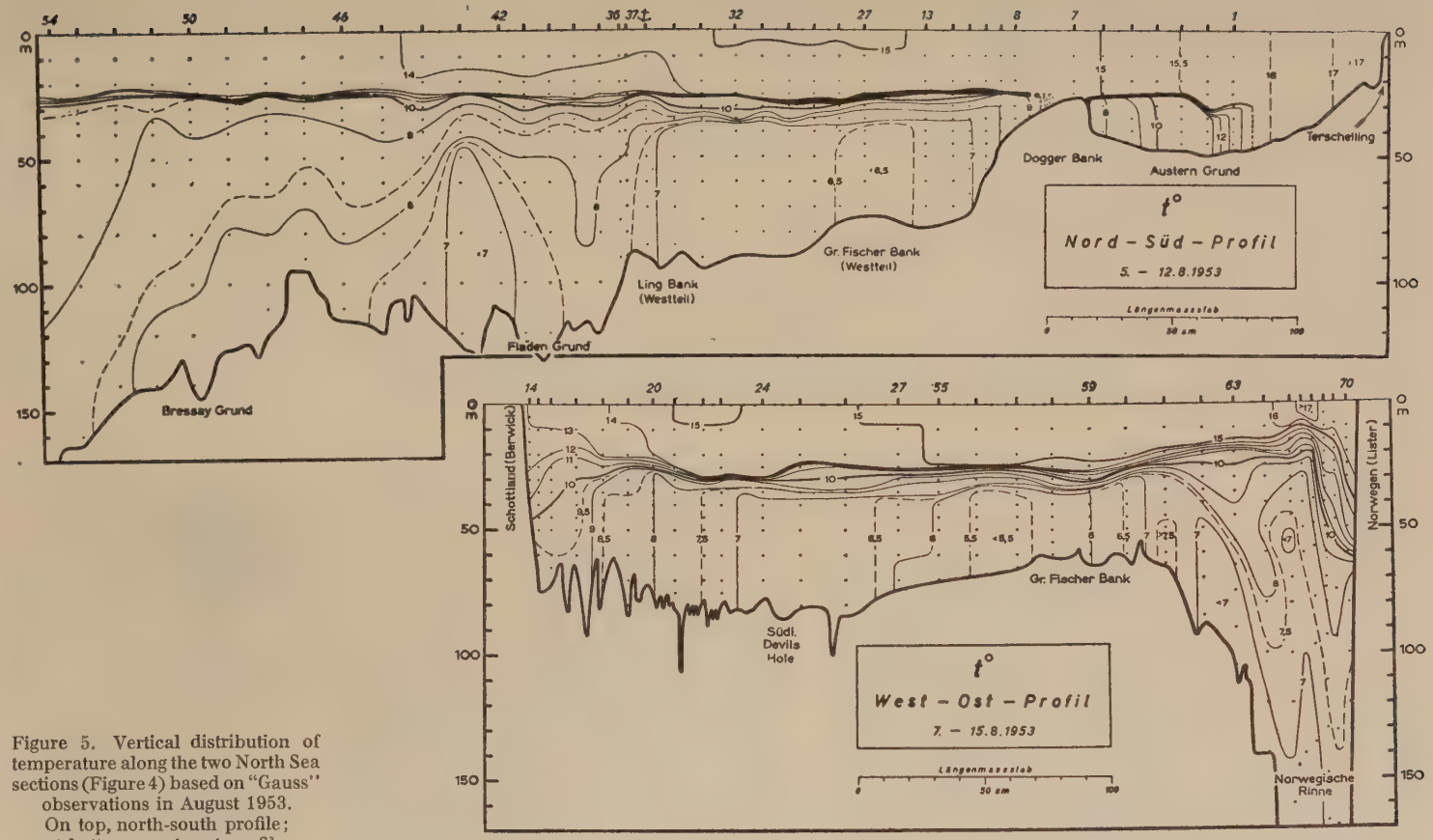


Figure 5. Vertical distribution of temperature along the two North Sea sections (Figure 4) based on "Gauss" observations in August 1953. On top, north-south profile; at bottom, west-east profile.

south of station 10, or to the waters west of station 24, being rich of tidal streams. The sub-stratum remains homothermal, the summer discontinuity layer becomes reduced to only a few decimetres thick:— for instance north and south of the Dogger Bank.

4. The mixing layer close to the bottom, dependent on the tidal streams, and that near the surface caused by the wind effect, intermingle. There is no longer a summer discontinuity layer. Examples of this are the southern North Sea, south of station 1, and the Scottish waters.

It is recognized that the temperature can change from summer to summer, but the typical distribution of the thermal stratification will always reappear since it is controlled by the tidal stream. The regional differences in the vertical mixing processes seem to be of far reaching importance for other physical, chemical and biological phenomena in the North Sea. Investigations on these problems are being made.

G. Dietrich.

Northern North Sea and Approaches.

General.

The extent and range of hydrographic operations conducted by the Scottish research ships and assisting vessels in 1953 are given in Table 2. Geographically, these operations covered the region from the northern North Sea through the Faroe-Shetland Channel to Iceland, and north-eastern Atlantic Ocean waters west of Scotland.

The year opened with evidence of strong Atlantic water influence in the central North Sea down to below latitude 56°N. between the prime meridian and longitude 1°E. Water of 35.30‰ salinity was found in mid-January on the latitude of Kinnaird Head.

In early February, salinities up to 35.46‰ on the hydrographic section from the Butt of Lewis to Faroe Bank gave similar indication of a strong Atlantic Current in the Faroe-Shetland Channel. Salinity remained at this comparatively high level off the Butt of Lewis during March, with coastal water influence apparently abnormally restricted.

Succeeding months until August showed a slow decline in the intensity of the Atlantic Current in the Faroe-Shetland Channel, with a considerable inflow of Arctic water into the deeper levels of the Channel, as has been a feature of practically every year since 1947. There seems little doubt that the strength of the Atlantic Current increased during the autumn, and in November, no evidence of deep Arctic water was obtained.

In the northern North Sea, although salinities in April indicated a fairly strong oceanic incursion southward into the region across latitude 61°N., very cold (6°C.) and fresh (34.52‰) water was encountered far westward from the coast of Norway in that month.

The general impression gained from cursory examination of the temperature/salinity distributions throughout the later spring and summer, is that oceanic influence remained fairly strong in the longitudinal band between 1°W. and 1°E., overlaid east of the latter longitude by fresher water influence from the Norwegian coast. The registration of Atlantic water salinity as far south as latitude 55°30'N. on the western side of the North Sea in the month of December, also bespeaks a strengthening of the incursion from the north in the autumn.

Drift-bottle liberations from and *en route* to Weather Station "J" (52°30'N., 20°00'W.) throughout the year resulted in only one stranding beyond the western shores of Great Britain. This one, from a January liberation, fetched up within the Skagerak the following December.

Table 2. Scottish Hydrographic Operations, 1953.

Vessel	Hydrographic Stations	Temper. Observations	Salinity Observations	Oxygen Observations	Phosphate Free	Phosphate Total	Drift-Bottles Liberations	Drift-Bottles Recoveries	Drift-Envelopes Liberations	Drift-Envelopes Recoveries
"Scotia"	766	5021	4304	863	1552	100	1210	284	500	15
"Explorer"	314	1912	1512	524	1044	32	385		—	—
"Clupea"	456	1489	1159	93	668	—	75		—	—
"Kathleen"	46	88	88	—	—	—	—	—	—	—
"Silver Scout"	147	448	328	—	164	—	—	—	—	—
"N. Carr" Lightship	99	99	99	—	—	—	—	—	—	—
Weather Ships	—	—	—	—	—	—	1335	83	—	—
Total	1828	9057	7490	1480	3428	132	3005	367	500	15

Table 3. Drift Bottles at Weather Stations "J" (A), and "I" (B), and in the Faroe-Shetland Channel (C) and the North Sea (D).

	Liberations		Recoveries Frequency-Distribution															
	Year	No. of Drifters	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
A	1953	660	23	12	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	36
B	1953	675	1	12	8	1	—	—	—	—	—	—	—	3	4	12	3	—	3	47
C	1953	635	3	22	26	8	—	—	—	—	—	—	—	4	2	31	7	1	2	106
D	1953	1035	—	—	4	4	—	7	—	—	—	1	4	54	22	75	6	—	—	177

Most of the strandings from this Weather Station took place on the west coasts of Ireland and Scotland, although three are to be recorded as having been returned from south-western shores of England. For the second successive year no French coast recoveries were notified thus providing a contrast with 1951. Details of the recoveries are given in Table 3 A, the column numbers of which, as are those of succeeding similar tables, are defined in the footnote to page 94 of *Annales Biologiques* 8 (1951).

Similar information in respect of the Weather Station "I" (61°00′N., 15°20′W.) is given in Table 3 B. In view of the position of this station, although similar recoveries have been recorded before, the return from Ireland is noteworthy. West and north Scottish coasts are usually represented in returns from Weather Station "I" as in Table 3 B. A significant number of the 25 recoveries beyond these shores definitely found their way into the North Sea. More may have done so before beaching in Norway beyond latitude 62°N. Skagerak recoveries took place in the months of October, November and December, and North Sea Norwegian coast recoveries in June (a single one) and November.

The total percentage drift-bottle return from the Weather Ships was 6.2, somewhat lower than for 1952.

Turning to liberations in the Faroe-Shetland Channel region and farther south off the west and south-west coasts of Scotland (Table 3 C), recoveries on west and north Scottish coasts preponderated, followed by returns from the Norwegian coast beyond the North Sea. The three Irish coast recoveries tabulated all emanated from liberations nearby in the month of October. The Skagerak and North Sea Norwegian coast recoveries from these liberations are significant in that they occurred between September and November, further evidence of increased oceanic activity towards and within the North Sea in these months.

Extra North Sea Norwegian returns from Faroe-Shetland liberations commenced with one made in the same month as liberation took place, namely, March, indicating a direct course overtaken at a high average speed, probably of the order of 10 to 12 nautical miles per day. This again is almost certain evidence, in view of the region involved, of a powerful Atlantic Current also in the early part of the year. Returns from the same coasts fell away during the summer and, like the Skagerak and North Sea recoveries, became more frequent again in autumn and winter months.

North Sea drift-bottle liberations are accounted in Table 3 D. All fifteen British coast returns except one took place in the winter, and were made from places to the north of the respective liberation-positions in the north-west and west central North Sea. They suggest a reversal along the Scottish coast of the normal southerly drift-current. On the other side of the North Sea, the months of September 1953 and January 1954 were best represented in the numbers of Skagerak recoveries, although these occurred in all months from May onwards with minima in August and November. North Sea Norwegian coast recoveries, however, were most numerous in November-December, while extra North Sea Norwegian returns came in considerable numbers from October onwards until February 1954 inclusive.

The conditions for the entire year, then, are fairly clear in broad outline. Strong oceanic influence in the beginning of the year, in the Faroe-Shetland Channel especially, was to be expected after an extraordinarily powerful Atlantic Current dynamically assessed in December 1952. This influence carried well down into the North Sea on its western side at least. It is probable that the Atlantic influx declined in intensity after the month of April, although the decline appears on the whole to have been comparatively small. Fresher water in-

fluence from the Norwegian coastal regions strongly affected the uppermost waters during the summer. From a minimum in August oceanic influence again waxed stronger in the autumn and reached considerable intensities towards the end of the year.

J. B. Tait.

Chemical observations.

The distributions of free phosphate (μg.-at. PO_4/P per litre) and dissolved oxygen (cc. O_2 per litre) are shown in Figures 6 and 7 for the winter of 1952—53 and in Figures 8 and 9 for June 1953. Winter values were selected according to the rules adopted for last year's contribution. Instead of a generalized summer picture, the arrangement of the cruises of the research ships "Scotia" and "Explorer" made it possible to obtain a widespread North Sea survey in June, thus providing increased precision in time. The fact that no oxygen data were obtained from the Faroe survey, and the failure to complete the Butt of Lewis—Faroe section, have seriously restricted the coverage for the oxygen chart in the Faroe region in June.

The stations sampled are indicated on the charts and in almost all cases the results are based on single surface observations.

It will be useful to have at hand a copy of the charts published in the Annales last year (pp. 99—103). Collateral information is available in the appropriate monthly *Synoptic Hydrographic Charts and Notes* prepared by the Council's Service Hydrographique. In particular, there are some marked differences in temperature and salinity values for the present period and for June 1952 for the northern North Sea area.

The main winter survey at Faroe was carried out in February 1953. Oxygen samples were not taken. The phosphate distribution was more varied than in 1952 when, despite the extreme simplicity of the isoline pattern, there was a similar number of observations. The most obvious difference is the decreased area enclosed by the 1.0 phosphate isoline in 1953. This is taken to infer a stronger influence from a southerly direction chiefly affecting the west side of the islands.

Failure to secure a complete section across the Faroe Channel allows only a guess to be made at the possible nutrient conditions there. On the Butt of Lewis—Faroe section, oxygen values were 0.1 to 0.2 lower than in 1952; the phosphate concentrations were also lower. The low oxygen value (6.19) in the Faroe Channel section near Muckle Flugga, and some indication of a possible greater penetration of the 6.4 and 6.5 oxygen isolines into the North Sea, are of note, although there is little accompanying difference in salinity and temperature distribution.

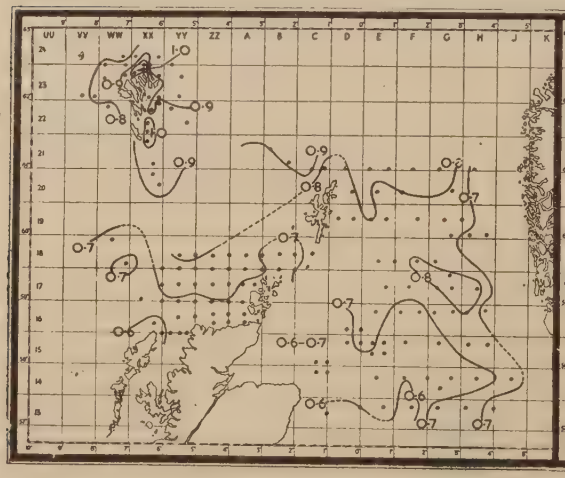


Figure 6. Free Phosphate. Winter 1952—53. μg.-at. Phosphate-Phosphorus per litre. Surface.

Figure 7. Dissolved Oxygen. Winter 1952—53. Cubic centimetres Oxygen per litre. Surface.

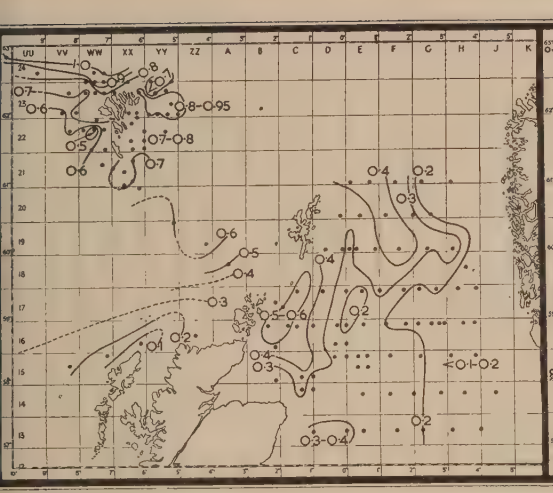


Figure 8. Free Phosphate. June 1953. μg.-at. Phosphate-Phosphorus per litre. Surface.

Figure 9. Dissolved Oxygen. June 1953. Cubic centimetres Oxygen per litre. Surface.

It will be seen that the greater part of the northern North Sea is included in the oxygen range 6.5—6.7, compared with 6.7—6.8 in the previous year. Areas of rather low oxygen content were found along a north to south line at roughly 3°E. between the main uniform area and the Norwegian coastal water of presumably high oxygen content, which was perhaps just encountered at the eastward limits of the survey. Water of oxygen content >7.0 was found at only one position (H 19 d), which perhaps indicates a lesser westward extension of the Norwegian coastal water than in 1952.

The phosphate results as a whole are close to the 1952 values. Differences which one might infer from the variations in the 0.7 isoline are, in fact, negligible, since all results lie close to 0.7 except near the southern boundary. A patch of rather high phosphate in areas G 17 and H 17, associated with rather low oxygen content, was found to coincide fairly well with a tongue of water of high temperature and salinity.

An interesting feature is that, in January and February 1952, there was a great extent of surface water of 35.4‰ and even 35.5‰ salinity in the Faroe Channel. Yet the 35.3‰ isoline extended much less into the North Sea on that occasion than in January and February 1953, when there was no water of 35.5‰ and comparatively little of 35.4‰ in the Faroe Channel. The associated oxygen values were higher with the higher salinity under similar temperature conditions, which is perhaps not what one would have anticipated.

The generalized charts for the summer of 1952 provide only a rather crude basis for comparison with June 1953, for they were taken to represent approximately mid-July. It is not unexpected therefore that the oxygen/phosphate values in the June 1953 chart are usually higher and show more marked traces of phytoplankton bloom.

Assuming no important changes in the water masses are involved, it is possible to use Figures 6 and 8 as guides to phytoplankton growth. At Faroe, a diminution of phosphate by 0.15—0.2 units occurred at inshore stations, presumably as a result of phytoplankton production. Greater decreases, amounting to 0.2—0.3 units, were found for WW22, XX21 and XX22, and in a very restricted area at 62°30′N. 5°30′W. (up to just over 0.2 units). All these instances were found in areas where the temperature was greater than 9°; elsewhere at Faroe the temperature was lower. To the south of the small area was a larger area showing little or no phosphate depletion.

There is evidence of a similar pattern of phosphate uptake in the 1952 figures.

The few oxygen values recorded for the Faroe Channel region were high, typical of previous results for this time of year. Those for the region to the west of the Hebrides were, in comparison, markedly low: much lower than those secured only a fortnight earlier in the Faroe Channel section. Phosphate concen-

trations also were low in the Hebrides region, thus tending to confirm the view that the phytoplankton outburst had been much earlier than in the south of the Faroe Channel.

A very interesting survey of the northern North Sea was secured in June. Four main zones emerge from a preliminary examination of the oxygen and phosphate results (Figures 8 and 9), namely: — (a) Scottish coastal waters with oxygen values of 6.1 — 6.5 units, phosphate $>$ 0.3 units; (b) a region of high oxygen content (6.4 — 7.0) and fairly low phosphate (ca. 0.3); (c) a region of low oxygen content (6.0 — 6.4) and low phosphate (ca. 0.2); and (d) Norwegian coastal water of high oxygen content (6.4 — 7.1) and depleted phosphate ($<$ 0.1 — 0.2).

In zone (a) the low oxygen content suggests that the main early phytoplankton outburst had probably been spent for some time, and it seems likely that the relatively high phosphate values are the result of tidal, current, or turbulent forces, particularly in the regions of Fair Isle and to the east of Peterhead. Similarly, the high oxygen and lower phosphate in zone (b) can be taken to indicate major phytoplankton activity in progress. Zone (c) probably shows the completion of the main early phytoplankton growth. This is possibly the zone of earliest phytoplankton activity in the northern North Sea. The Norwegian coastal water, zone (d), has as its most prominent feature depleted phosphate and high oxygen concentrations.

The detailed examination of the phosphate and oxygen results is being continued at least for another year with the object of describing the normal phosphate and oxygen cycles in this region and the annual variations which occur.

R. Johnston.

Defined Coastal Influence.

A measure for the presentation of salinity observations in coastal areas.[1]).

It will be generally agreed that salinity data, clearly presented, are of great value to the understanding of biological differences between different regions of the sea. It will also be agreed that in an area such as the North Sea, a difference of 0.1 $^0/_{00}$ between say 35.3 and 35.4 $^0/_{00}$ may well be important and worthy of attention, whereas at lower values such as 33 $^0/_{00}$ a difference of 0.1 $^0/_{00}$ would not be regarded as biologically important. In great areas of the North Sea, where Atlantic influence is strong, it is found that salinity values are, in general, fairly constant, and a change in value of 0.1 $^0/_{00}$ can be regarded as significant, the range of variability encountered in years of observation perhaps not exceeding 0.2 $^0/_{00}$. In regions of lower salinity, such as 33 $^0/_{00}$, we may commonly find changes much larger than this, frequently of the order of 1 $^0/_{00}$.

In other words, the *variability* of salinity is much higher for low values than it is for high ones, and the accuracy required for biological purposes is also much less. When salinity charts are drawn for an area which includes both oceanic and coastal conditions, one finds that unnecessary detail is shown in the coastal regions, while small significant differences in the open sea areas may be missed out. To avoid this, it is of course quite common practice to change the intervals of the isohalines, showing perhaps 35.1, 35.2, ... and perhaps only 33.5, 34, 34.5 ..... This means however that the value of the eye-picture, is destroyed, as the general arrangement of water masses can only be appreciated after checking the value for each isohaline carefully.

The writer has had occasion to prepare many such charts, the results of area surveys, and he has come to the conclusion that it would be better to convert salinity values to another form before plotting them on charts; he has used this method in his contributions to this year's *Annales Biologiques*. The measure used is Defined Coastal Influence (D.C.I.), and its value is $1 + \log_{10}(35.5 - S)$ where S is the salinity in parts per thousand. The reasons for adopting this measure are as follows: —

We have oceanic water of fairly constant high salinity in communication with the North Sea. Variations in salinity below this value are to be attributed in part to excess of precipitation over evaporation, and in greater degree to the diluting effect of rivers. A very large effect is of course due to the outflowing water of the Baltic. If the Atlantic water were perfectly constant in salinity, it would be

[1]) This note is introduced here to give a brief account of a method of illustrating salinity distributions which is used in the following note and also on p. 16 of this number.

natural to think in terms of the amount of dilution it has suffered at any point, and use the proportion of added fresh water as a measure of conditions at that point. If this were done it would be found that the variability of this proportion was always roughly proportional to its amount, in other words that we would have values like 0.01 ± 10 % or perhaps 0.2 ± 10 %, and it would be natural to plot such a quantity on a logarithmic scale, so as to keep all the data equally significant. It would be found that equal differences in the logarithm were of roughly equal importance biologically.

The writer has in mind the use of some agreed standard for the base water in any area, e.g., Faroe—Shetland Atlantic water for the North Sea, and the expression of all data as the logarithm of the dilution. For other areas, some other base value would be appropriate. In order to cope with odd high values, we must not take our base salinity too low, or we may get ridiculous D.C.I. values, and for the North Sea and adjacent values he has adopted a salinity value of 35.5 ‰. If this is used it will be found that North Sea data can be expressed in a convenient way.

That this problem of presentation has exercised others in the past is illustrated by the paper of Lucas and Rae (Hull Bull. Mar. Ecol., 3 (17) 1, 1946). This paper dealt with the hydrological background to a study of the North Sea plankton. After consideration of the same sort of factors as the writer has mentioned above, Lucas and Rae introduced a special code for the presentation of their surface salinity data. While this was adequate for the purpose intended, the writer feels that it is not a method likely to be generally adopted, nor is it of course suitable for the presentation of hydrographic charts and sections.

Below is given a conversion table covering all values of salinity commonly met with in the

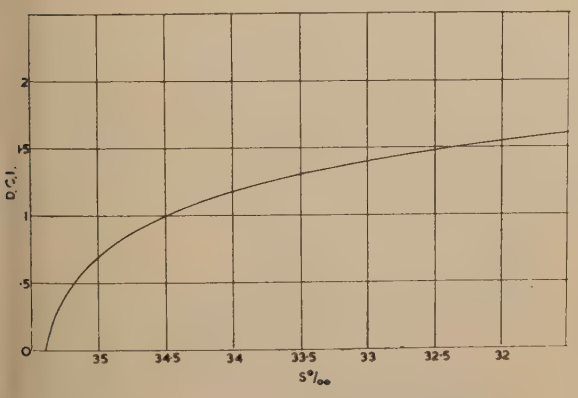


Figure 10. D.C.I. plotted against salinity.

Table 4. Conversion Table — Salinity to D.C.I.

S ‰	D.C.I.	S ‰	D.C.I.	S ‰	D.C.I.
15.0	2.31	30.9	1.66	34.86	.81
15.5	2.30	31.0	1.65	34.88	.79
16.0	2.29	31.1	1.64	34.90	.78
16.5	2.28	31.2	1.63	34.91	.77
17.0	2.27	31.3	1.62	34.92	.76
17.5	2.26	31.4	1.61	34.93	.76
18.0	2.24	31.5	1.60	34.94	.75
18.5	2.23	31.6	1.59	34.95	.74
19.0	2.22	31.7	1.58	34.96	.74
19.5	2.21	31.8	1.57	34.97	.73
20.0	2.20	31.9	1.56	34.98	.72
20.5	2.18	32.0	1.54	34.99	.71
21.0	2.17	32.1	1.53	35.00	.70
21.5	2.15	32.2	1.52	35.01	.69
22.0	2.13	32.3	1.51	35.02	.68
22.5	2.12	32.4	1.50	35.03	.67
23.0	2.10	32.5	1.49	35.04	.66
23.5	2.08	32.6	1.47	35.05	.65
24.0	2.06	32.7	1.45	35.06	.64
24.5	2.04	32.8	1.44	35.07	.63
25.6	2.00	32.9	1.42	35.08	.62
25.8	1.99	33.0	1.40	35.09	.61
26.0	1.98	33.1	1.38	35.10	.60
26.2	1.97	33.2	1.36	35.11	.59
26.4	1.96	33.3	1.34	35.12	.58
26.6	1.95	33.4	1.32	35.13	.57
26.8	1.94	33.5	1.30	35.14	.56
27.0	1.93	33.6	1.28	35.15	.54
27.2	1.92	33.7	1.26	35.16	.53
27.4	1.91	33.8	1.23	35.17	.52
27.6	1.90	33.9	1.21	35.18	.51
27.8	1.89	34.0	1.18	35.19	.50
28.0	1.87	34.1	1.15	35.20	.49
28.2	1.86	34.2	1.12	35.21	.47
28.4	1.85	34.3	1.08	35.22	.45
28.6	1.84	34.4	1.04	35.23	.44
28.8	1.82	34.5	1.00	35.24	.42
29.0	1.81	34.50	1.00	35.25	.40
29.2	1.80	34.52	.99	35.26	.38
29.3	1.79	34.54	.98	35.27	.36
29.4	1.78	34.56	.97	35.28	.34
29.5	1.78	34.58	.96	35.29	.32
29.6	1.77	34.60	.95	35.30	.30
29.7	1.76	34.62	.94	35.31	.28
29.8	1.76	34.64	.93	35.32	.26
29.9	1.75	34.66	.92	35.33	.23
30.0	1.74	34.68	.91	35.34	.21
30.1	1.74	34.70	.90	35.35	.18
30.2	1.73	34.72	.89	35.36	.15
30.3	1.72	34.74	.88	35.37	.12
30.4	1.71	34.76	.87	35.38	.08
30.5	1.70	34.78	.86	35.39	.04
30.6	1.69	34.80	.85	35.40	.00
30.7	1.68	34.82	.83		
30.8	1.67	34.84	.82		

North Sea. In Figure 10 is shown the relationship in graphical form, and in Figure 11 is a presentation of conditions in 1936 on the line Shields—Oslo. Figure 11 a is the presentation by LUCAS and RAE, and Figure 11 b the same data expressed as D.C.I. This example demonstrates clearly the convenience of D.C.I. as a means of presenting data of this kind.

There remain two important points for consideration.

(1) Linear interpolation of D.C.I. values makes different assumptions from linear interpolation of salinity values. To take an extreme case we may have to interpolate on a chart between two adjacent salinity values of 35.4 and 34.5, i.e., or D.C.I. values of 0 and 1. If we interpolate on a salinity chart, we obtain a value for the mid-point 34.95 $^0/_{00}$. If we interpolate on a D.C.I. chart we obtain for the mid-point a D.C.I. value of 0.5 corresponding to a salinity of 35.19 $^0/_{00}$. The writer's experience suggests that the latter value is a more reasonable one to expect in the circumstances. To look at the matter in another way, if at one point we have 100 parts per $^0/_{00}$ of diluting water and at another we have only 1 part $^0/_{00}$, then interpolation of the D.C.I. values gives a mid-point value of 10 parts $^0/_{00}$ as against 49.5 parts $^0/_{00}$ for interpolation of salinity values. In the case of adequately detailed surveys, of course, the differences resulting from interpolation are negligible.

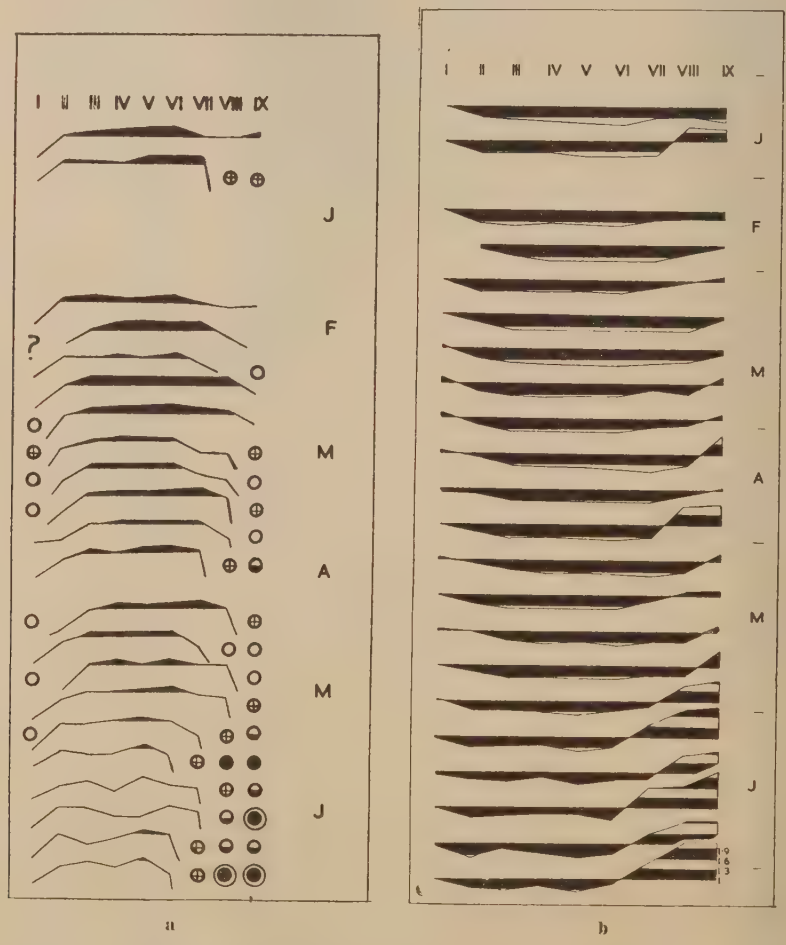


Figure 11. Salinities Shields—Oslo 1936 presented (a) after LUCAS and RAE (1946) and (b) in the form of D.C.I.

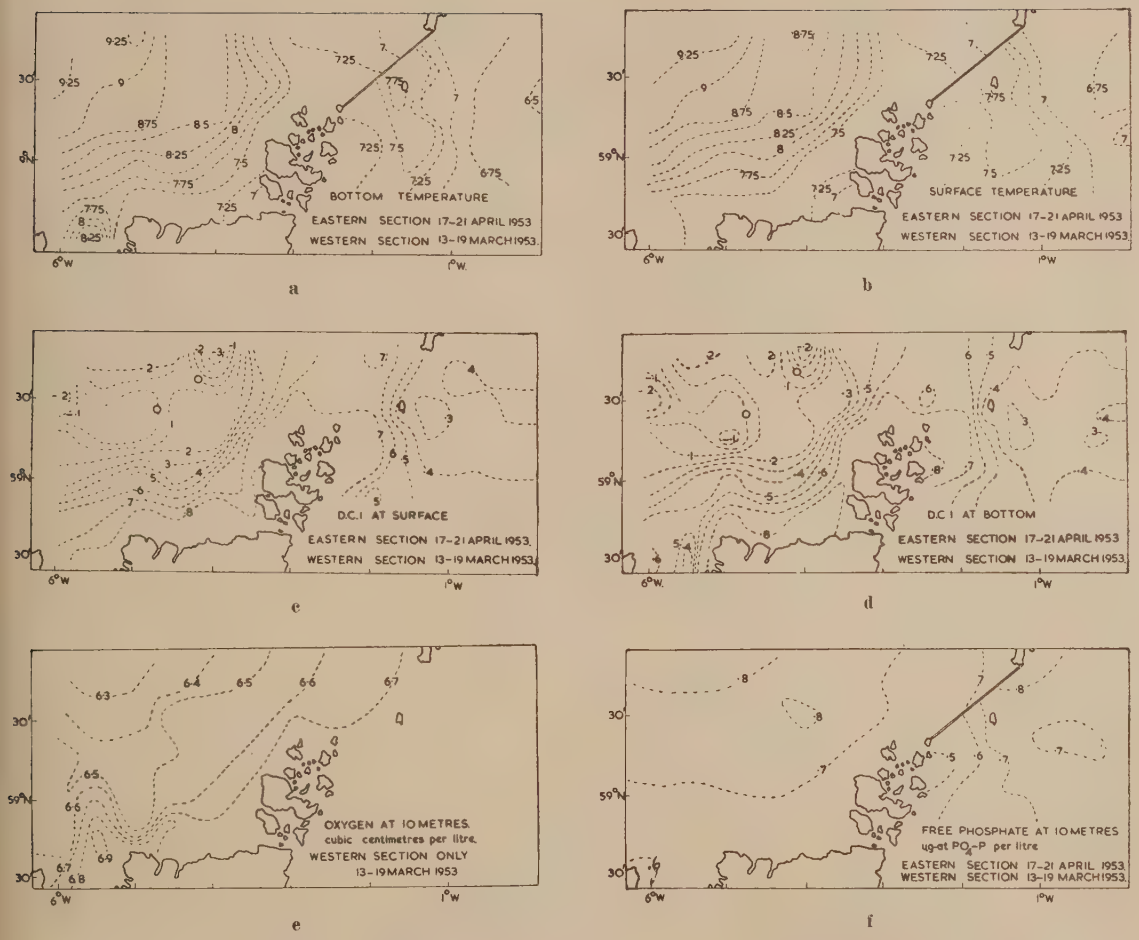


Figure 12. Temperature and salinity surveys of north coast of Scotland during the spring of 1953.

(2) If presentation in the form of D.C.I. is adopted in other coastal regions, with an appropriate base salinity related to the adjoining oceanic water, it may well be found that the values, dependent as they are on the amount of dilution from the land, have a more general ecological significance than the actual salinity values. This is however a matter on which judgment must be withheld for the present.

R. E. Craig.

Hydrographic Conditions off the North Coast of Scotland in March-April.

Detailed surveys of the region east and south of Fair Isle were reported in *Annales Biologiques* 1952, pp. 107—112. It was concluded that at the time of these surveys there was an inflow of relatively warm coastal water from the west through the channel south of Fair Isle, which was an important feature of the North Sea in the area west of 1°30′W. and south to about 58°N. It was also suggested that there was a slight inflow of oceanic water to the North Sea through the channel to the north of Fair Isle, and that this was most marked in the lower strata of water. The hydrographic observations were supported by plankton data, and it was suggested that repetition of this work, associated with "a similar survey of the relatively unstudied area 50—60 miles west of the Shetland and Orkney Islands" should be carried out to clarify the situation.

It was therefore planned in 1953 to cover the area Butt of Lewis—Fair Isle—Aberdeen, within a period of a fortnight, but very unfortunately this could not be achieved owing to delays in refitting the research vessel "Clupea". The data here described were obtained on two occasions, the area west of Fair Isle being surveyed by "Scotia" on 13. to 19. March, and the area east of Fair Isle being covered in the period 17.—21. April. The results are reproduced as charts (Figs. 12 a-f). and a line separating the two surveys has been introduced in the case of temperature and free phosphate results, no attempt being made to link the isolines. In the case of salinity however, which is presented as D.C.I., the charts have been constructed as if the surveys had been simultaneous.

The quantity D.C.I. (which is here equal to $1 + \log_{10}$ (35.5 $S^0/_{00}$)) has been used to bring out detail equally in areas of both high and low salinity without arbitrary and abrupt changes in the intervals of the isolines. Its value is more fully described in the previous note in this issue.

The details from the region west of Fair Isle are of interest in themselves, since this region has not been studied in such detail in the past.

(1) There is a fairly well-defined boundary between oceanic and coastal conditions lying roughly NE.—SW. about 30 miles from the coasts of Orkney, Scotland, and the Hebrides. This boundary lies therefore about halfway across the continental shelf, and is well defined in terms both of temperature and D.C.I.

(2) There is a close correspondence between values of D.C.I. at surface and bottom almost everywhere except in the North Minch. This suggests that whatever may have been the diluting influences, there has been time for complete vertical mixing to take place since their action. It implies also that movements of the surface and deep water must have been almost identical since the mixing occurred, if indeed it was not still going on at the time of the surveys.

(3) The results are again consistent with a flow of western coastal water through the channel south of Fair Isle, as described for 1952. They make it clear that there was *no oceanic inflow* via the Orkney—Shetland passage, and that the more oceanic conditions east of Fair Isle must have been derived from the north.

(4) The last report suggested that "It will be of interest to see whether the very obvious high salinity area, extending from about 59°40′N. to 58°N. proves to be a consistent feature". This feature did in fact occur again in 1953, D.C.I. east of Fair Isle being lower than east of Shetland. This is a *most important phenomenon*, and is worthy of the attention of hydrographers. Reference to the previous salinity charts (Ann. Biol. for 1952, p. 109) shows that observations in 1952 did not extend far enough west to settle the question, but they were drawn to imply that this water had penetrated the Shetland—Fair Isle Channel. It is an open question whether such an inflow to the North Sea ever occurs, but the results reported here make that hypothesis seem rather unlikely, and suggest that the higher salinities in this region require some other explanation. It has to be noted that high salinities occurred here both at surface and bottom in April 1952, August 1952 and April 1953. In August there was certainly no vertical mixing, so explanations dependent on factors like local variations in evaporation have to be ruled out.

(5) **Phosphate and oxygen values.** There is no indication of significant phytoplankton activity in the area, in fact the free phosphate values are appreciably higher than in April 1952, in the region where values exist for both years. In general, phosphate values less than 0.7 μg.-at. phosphate-phosphorus per litre are associated with oxygen values greater than 6.6 ml. O_2 per litre, and phosphate in excess of 0.8 with oxygen values less than 6.3. These classes correspond fairly well with western coastal water and oceanic water.

The difference between conditions in the North Minch and those in the region immediately to the north is quite marked. In the Minch are to be found much the highest oxygen values of the whole survey, and here also is the only distinct vertical stratification, the bottom water being warmer than the surface, and having a considerably higher salinity.

R. Johnston, R. E. Craig.

Hydrographic Conditions in the Southern North Sea, the "Bløden" Ground Area in 1953.

This year we have Danish observations over the "Bløden" Ground area from all months except June and September. The M/S "F. V. Mortensen" took observations in January,

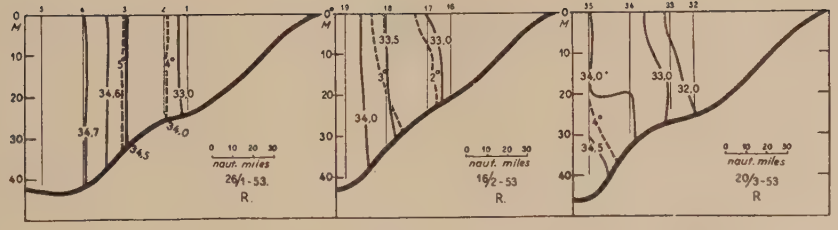


Figure 13.

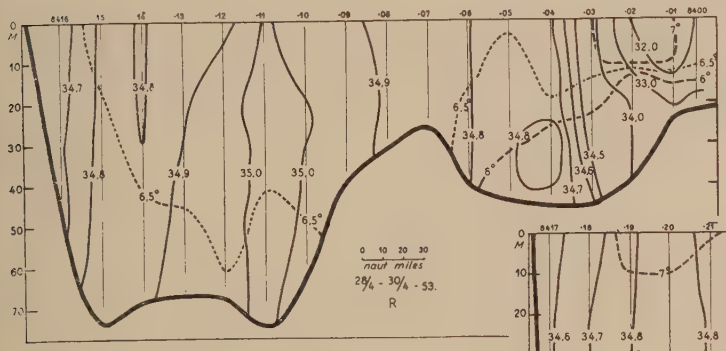


Figure 14.

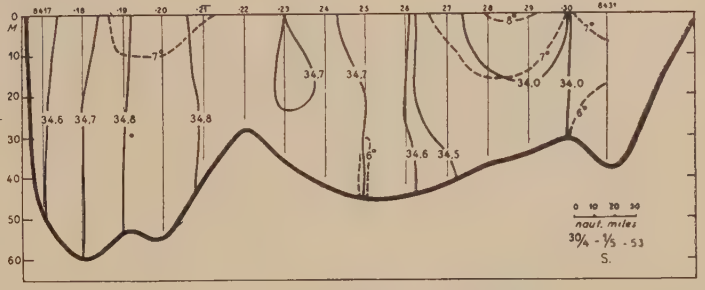
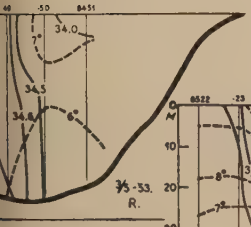


Figure 15.



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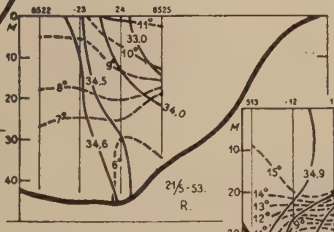


Figure 16b.

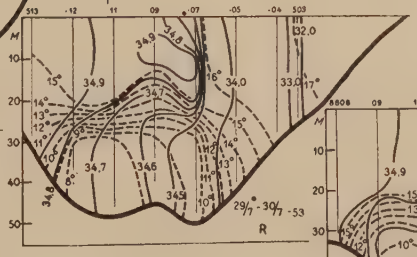


Figure 17a.

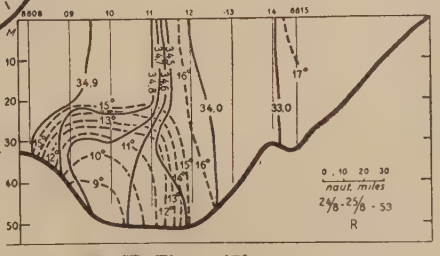


Figure 17b.

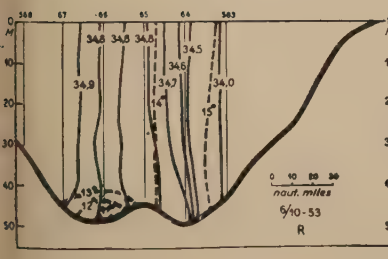
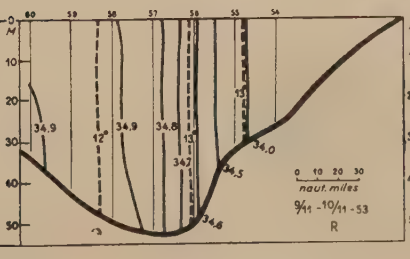


Figure 18.



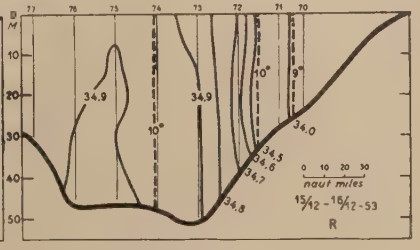


Figure 18a.

Figures 13-18. Temperature and salinity in the "Bløden" Ground area, 1953.

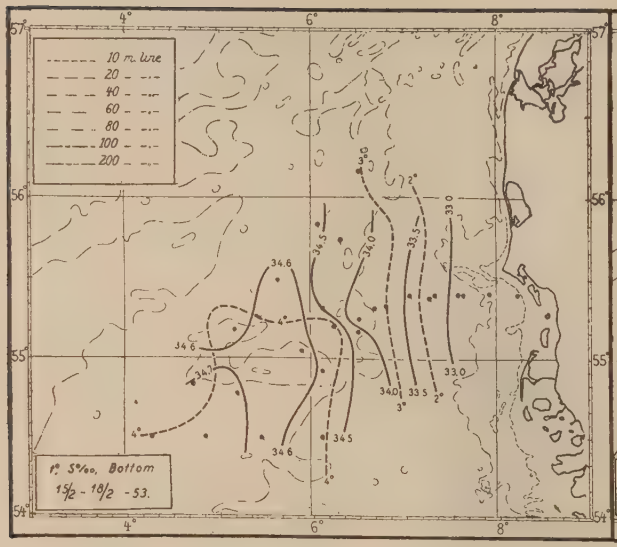


Figure 19.

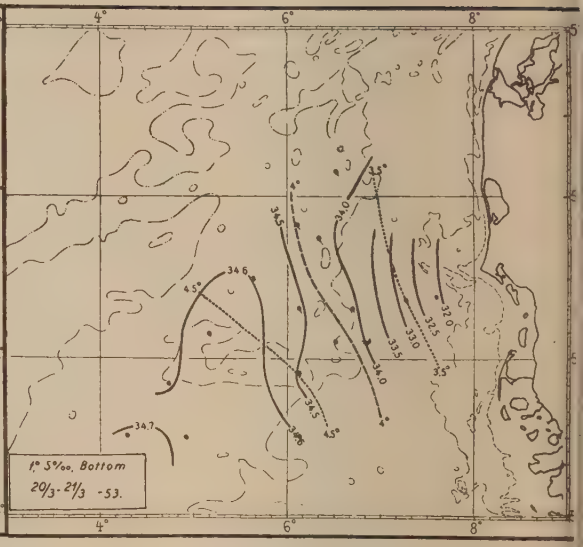


Figure 20.

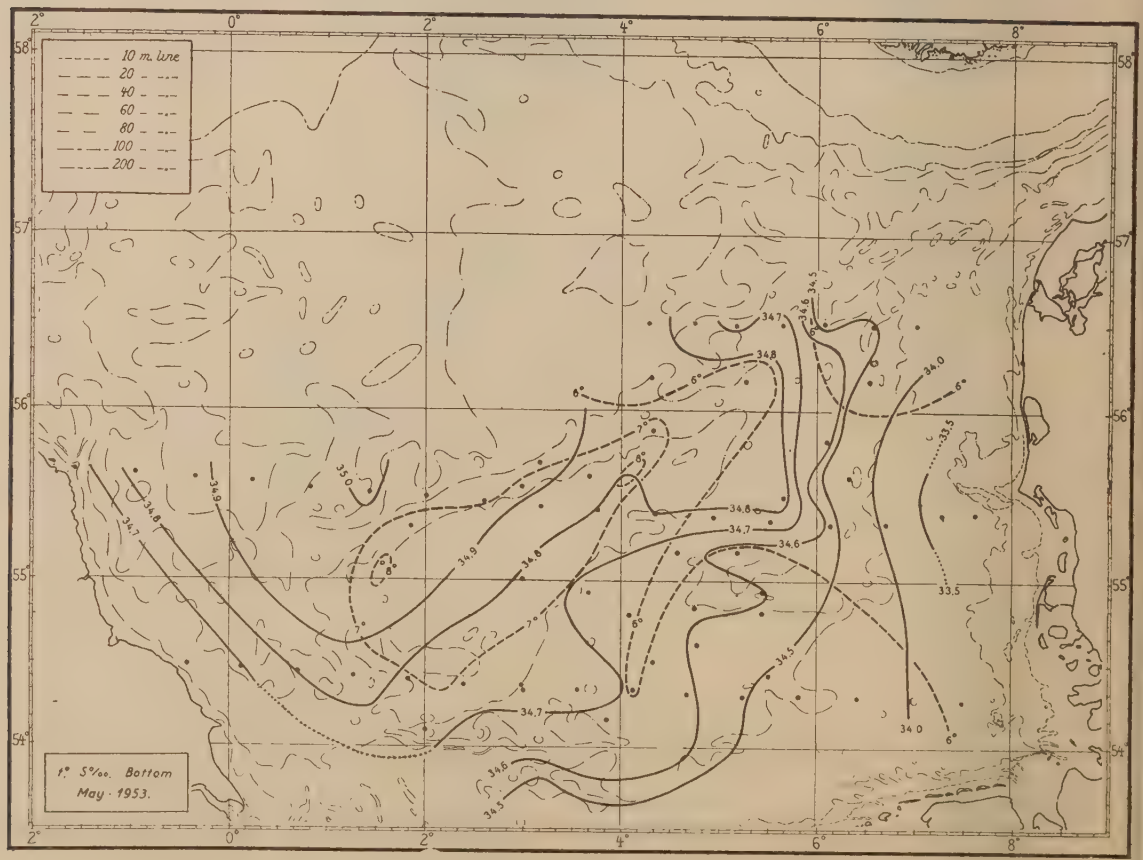
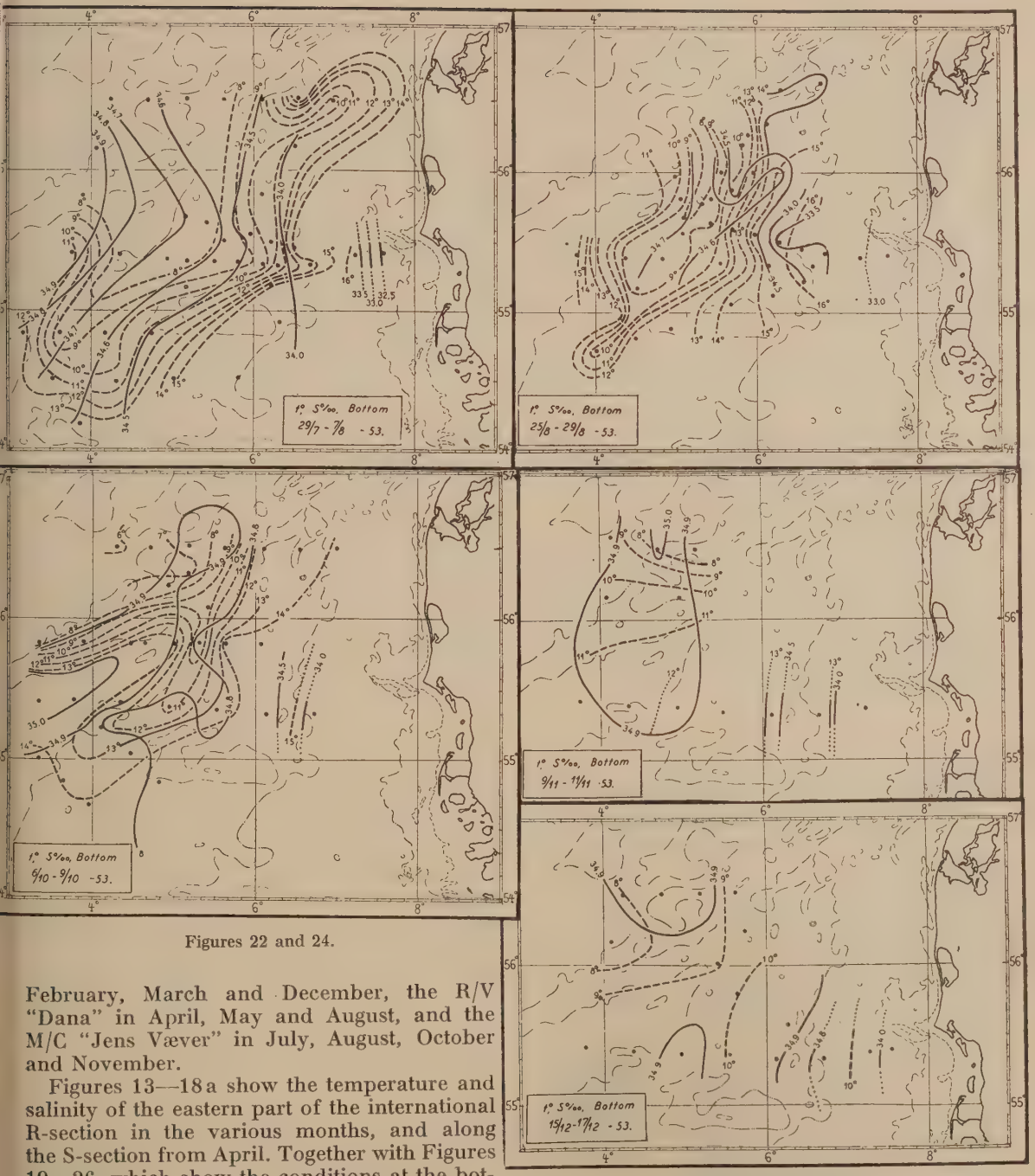


Figure 21.



Figures 22 and 24.

Figures 23, 25 and 26.

February, March and December, the R/V "Dana" in April, May and August, and the M/C "Jens Væver" in July, August, October and November.

Figures 13—18a show the temperature and salinity of the eastern part of the international R-section in the various months, and along the S-section from April. Together with Figures 19—26, which show the conditions at the bottom in each month, Figures 13—18a give a useful picture of the development of conditions in the "Bløden" Ground in 1953.

In January, February and March the isotherms and the isohalines were nearly vertical. We found that a strong mixing of the waters

from the surface to the bottom had taken place — a consequence of the winter cooling and gales. The lowest temperatures were found near the west coast of Jutland — also a consequence of the winter cooling, which reached its maximum in February.

In April and May we found comparatively low bottom temperatures in the "Bløden" Ground, as a cold tongue with temperatures less than 6° C. stretched over the "Bløden" Ground from the north and had connexion with the coastal waters.

The cold tongue became more clear in the course of the summer, to be most distinct in August.

The coastal waters and the Dogger Bank waters were influenced by the summer heating from surface to bottom, whereas the bottom temperature at the "Bløden" Ground rose very slowly. This phenomenon can presumably be explained by weak tidal currents and consequently slow vertical mixing.

In August the bottom temperature in the cold tongue was only 3° higher than in May and was still below 8°, whereas the temperature in the surrounding waters ranged from 10° to 16°. The cold tongue then disappeared gradually from the "Bløden" Ground, presumably as a consequence of mixing caused by the beginning autumn gales.

In October little remained of the cold bottom water in the R-section and most of the waters were completely mixed.

In November and December the cold water had quite disappeared from the R-section.

The sections do not indicate any distinct connexion between the salinity and the temperature. But the cold water was somewhat richer in phosphate than the surrounding waters. Phosphate determinations were carried out in April, May and August. On the April—May cruise we found in the cold tongue (but not in the coastal waters) a phosphate concentration of 0.4—0.6 μg.atom/l., whereas the concentration in the surrounding waters was 0.0—0.1 μg.atom/l. Similar conditions were found in August (with 0.4 μg.atom/l. in the cold tongue and 0.0—0.1 μg.atom/l. in the coastal region and over the Dogger Bank).

The oxygen at the bottom was determined in August and we found that there was an oxygen minimum in the eastern boundary of the cold tongue. In the minimum area the saturation was 70—80 %, whereas at other places it was 90 %.

The conditions in 1953 are presumably characteristic for this area as similar conditions have been found since 1947 (although information from preceding years was less detailed than in 1953).

Knud P. Andersen.

Table 5. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department.)

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity						**Surface**						
Mean.....	32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6	32.4	32.4	32.9
1953.....	0.4	0.0	0.0	—0.9	—	—	—	0.3	—0.2	—0.3	0.3	0.4
						Bottom						
Mean.....	33.0	32.8	32.7	32.8	32.6	33.1	32.9	32.6	32.7	32.6	32.6	33.0
1953.....	0.3	0.0	—0.3	—0.6	—	—	—	0.3	—0.2	—0.2	—0.6	0.8
Temperature						**Surface**						
Mean.....	3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0	12.2	8.5	5.4
1953.....	0.6	—0.3	0.6	0.9	—	—	—	0.6	0.6	1.7	3.2	3.2
						Bottom						
Mean.....	3.9	2.6	3.0	4.7	7.9	11.1	14.1	16.0	15.1	12.7	9.1	6.2
1953.....	0.0	—0.2	0.3	0.4	—	—	—	0.6	0.6	1.3	2.9	2.9

Helge Thomsen.

Plankton.

The Continuous Plankton Recorder Survey: Plankton around the British Isles during 1953.

Thanks to continued co-operation by the Ocean Weather Ships and a number of commercial vessels, the scope of the Recorder survey during 1953 was similar to previous years (Figure 27). Sailing schedules, bad weather and certain misfortunes led to more gaps in the data than in some recent years, but nevertheless, for the sake of continuity, histograms summarizing the abundance of various forms on selected routes have been prepared as in each year since 1948[1]). Again, it should be stressed that these histograms are only intended to provide the broadest summary. They give an estimate of the average number of animals collected by the Recorder at 10 metres depth along various routes in each month. The aperture in the nose of the Recorder is $^1/_2{}''$ square, and it is presumed that about 0.25 of a cubic metre of water passes through the machine for every mile it is towed. No account is taken of diurnal migration of the plankton or of the considerable variations in the quantity of plankton along the route. As in 1952, the H and J routes, which are sampled by the Netherlands Weather Ships, have been combined; H was sampled from January to March and J from April until August.

The very gross estimate of phytoplankton (Figure 28) which is based on the "greenness" of the filtering silk[2]), suggests some unusual features in 1953. In the two previous years for which we have had data from the J route, there was a well-defined diatom maximum in May and little "greenness" at other times of the year. It was surprising, therefore, to take very rich catches during June and July 1953, in which *Rhizosolenia styliformis* was a prominent constituent. *Rh. styliformis* and *Rh. alata* were also widespread in the June samples on W. There was some indication that in 1953 the main outburst of diatoms on route X preceded slightly that on the more southerly

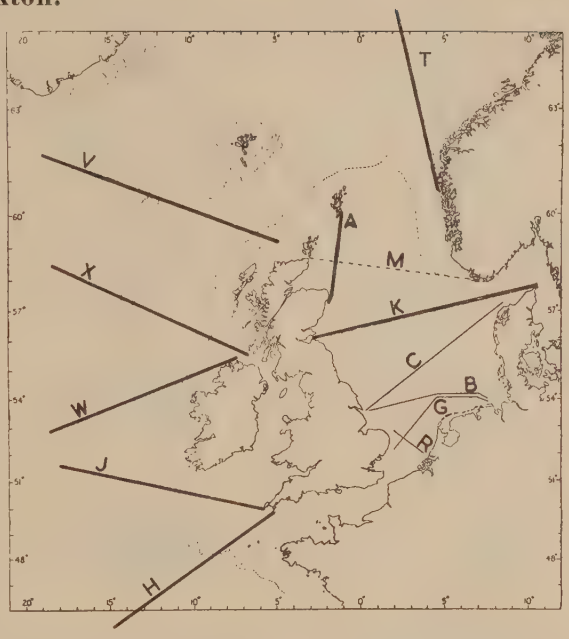


Figure 27. A chart showing the routes along which the Continuous Plankton Recorder was usually towed monthly during 1953. The routes indicated by the heavier line, i.e., H & J, W, X, V, T, A, and K, are those selected for this summary. Route M was sampled only occasionally. The dotted line marks the position of the 100-fathom contour.

W — which is contrary to previous findings in our survey and also to the more exact assessment made from 1948—1950 at the weather stations by CORLETT[1]). The slight "greenness" on X in March was due to the extension of the coastal crop of diatoms a few miles beyond the 100-fathom contour but by the end of April *Thalassiosira*, *Thalassiothrix* and chaetocerids extended well along the route to develop into a rich population by mid-May. Large numbers of chaetocerids on T at the end of May were also unusual when compared with our earlier results; in 1950, 1951 and to a lesser extent in 1952 appreciable quantities of phytoplankton were restricted to the late summer or autumn on this route. In 1953, diatoms showed an unusually early start in the North Sea; by mid-March quite exceptionally large numbers of spring forms such as *Rh. semispina*, *Thalassiosira* and chaetocerids were taken over the eastern half of the K route.

[1]) Ann. Biol., **5**, **6**, **7**, **8**, and **9**.

[2]) The silk, when first unloaded from the Recorder, is compared with an arbitrary colour scale. Note is taken of the proportion of its length — or its area — which is coloured "dark green", "green" or "pale green". The overall height of any cell in the histogram gives, therefore, a rough measure of how widespread phytoplankton was, whereas the cross-hatching indicates its abundance in the more concentrated patches.

[1]) Journ. Cons. Int. Explor. Mer, **19**, 2, 1953.

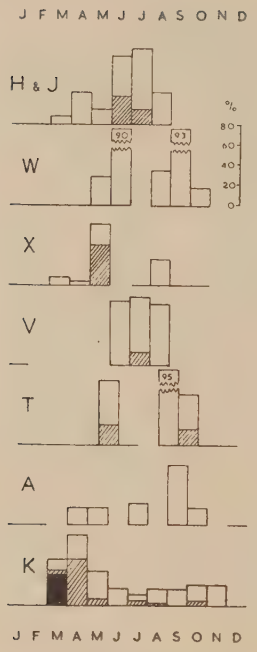


Figure 28.

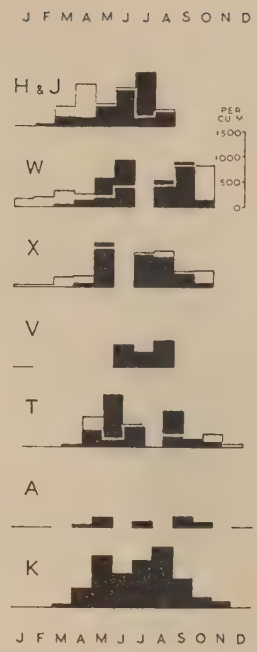


Figure 29.

Figure 28. An estimate of the density of *Phytoplankton* month by month on the Recorder routes, H & J, W, X, V, T, A, and K. The histograms show the percentage of the route which sampled water containing various quantities of phytoplankton as estimated by comparing the colour of the filtering silk with an arbitrary colour scale; only that part of the record taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T. The open part of the histogram represents "pale green", the hatched part "green" and the blacked part "dark green". A gap in the base line indicates that no data were available in the particular month.

Figure 29. Histograms representing the relative numbers of *Total Copepoda* (all species combined) taken month by month on the Recorder routes H & J, W, X, V, T, A, and K. The values represent the number of copepods per cubic metre either for the whole length of tow on routes A and K or for the two parts of the tow which lie on either side of the 100-fathom contour on routes H & J, W, X, V, and T when the solid histogram shows the numbers over the deeper water and the open histogram over the shallower or coastal water. A gap in the base line indicates that no data were available in the particular month.

The "total copepods" (Figure 29) conformed fairly closely to the usual pattern. Although there were no catches comparable to those of 1949 and 1952 in the Atlantic, copepods were again relatively abundant several hundred miles offshore; as before *Acartia clausi* was the commonest form. There seems little doubt now after six years of sampling on routes X and W that as many copepods are to be found at 10 metres depth well out into the Atlantic as in coastal waters or within the North Sea, although their seasons of abundance may be shorter and tend to fall later in the year.

Calanus copepodid stages V and VI and all ages combined are illustrated in Figures 30 and 31 respectively. Again, the northerly distribution of *Calanus* is brought out. On X and on V, as far as the limited data show, it was concentrated near the coast.

The prominence of an autumn generation inside the 100-fathom contour on X is a recurring feature. Elsewhere the preponderance of the April/May generation has always been overwhelming. It is interesting to note how consistent these spring populations can be numerically. If one takes the highest monthly average attained for "total *Calanus*", one finds for the years in which data are available the following figures on the K route:—435 per m.^{3} in May 1948, 528 in April 1950; 630 in May 1951, 653 in April 1952, and 650 in May

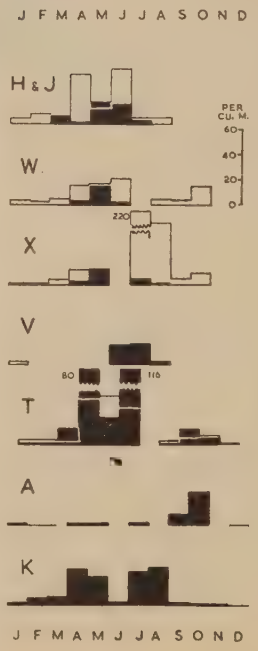


Figure 30.

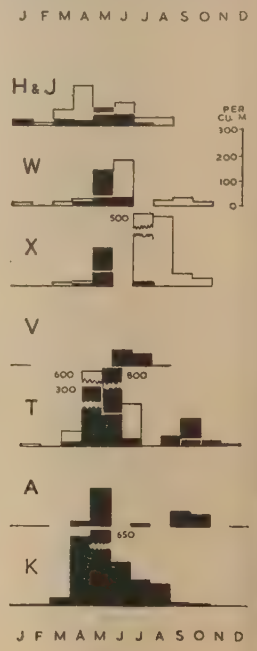


Figure 31.

Figure 30. Histograms representing the relative numbers of *Large Calanus* (copepodid stages V and VI) taken month by month on the Recorder routes H & J, W, X, V, T, A, and K. Details as in Figure 29.

Figure 31. Histograms representing the relative numbers of *Calanus* (all stages combined) taken month by month an Recorder routes H & J, W, X, V, T, A, and K. Details as in Figure 29.

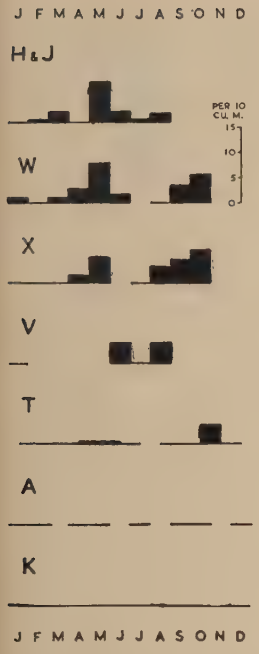


Figure 32.

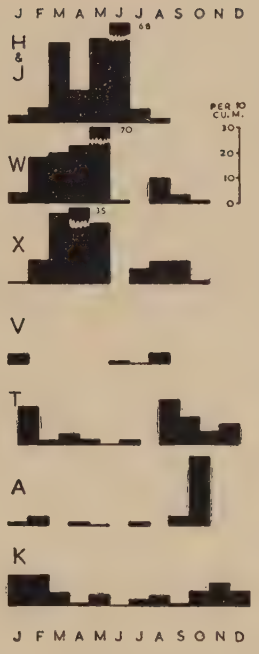


Figure 33.

Figure 32. Histograms representing the relative numbers of *Euchaeta* spp. taken month by month from the Recorder routes H & J, W, X, V, T, A, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 29.

Figure 33. Histograms representing the relative numbers of *Metridia lucens* taken month by month from the Recorder routes H & J, W, X, T, V, A, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 29.

1953; while over the deeper part of T — 642 in June 1950, 900 in May/June 1951, 752 in April/May 1952 and 800 in May/June 1953. On each route there is only about 20 % variation from the mean.

Since 1948, when these summaries were commenced, there seems to have been some change in the time of occurrence of *Euchaeta* spp. on the Atlantic routes, W and X. During 1948, 1949, and 1950 — except for very few individuals taken in April and May — the season appeared to be restricted from about August until October. This was attributed to seasonal differences in vertical distribution; it was thought that *Euchaeta* only rose to the 10-metre level, which is sampled by the Recorder, during the late autumn. In 1951, *Euchaeta* spp. enjoyed a longer period on these two routes and by 1952 it was quite abundant during April and May on W and during June and July on X. In 1953 it was again very well represented in May on both routes (Figure 32). At least three species, *E. norvegica*, *E. hebes*, and *E. acuta*, are taken by the Recorder, although they are not always differentiated in their younger stages during the routine analyses. However, the explanation that this apparent change in the season of occurrence is due to some change in the dominant species is unlikely; *E. norvegica* has been the commonest form throughout.

Although the maximum numbers of *Metridia lucens* (Figure 33) taken on W and X during the summer of 1953 were not as high as in the previous two years, the species was still above average abundance. The unusually dense populations found on T and K during the later months of 1952 carried on into the beginning of 1953 and to a lesser extent this was also true on A.

Taking the "indicator" forms as a whole over the past years, it has usually been pos-

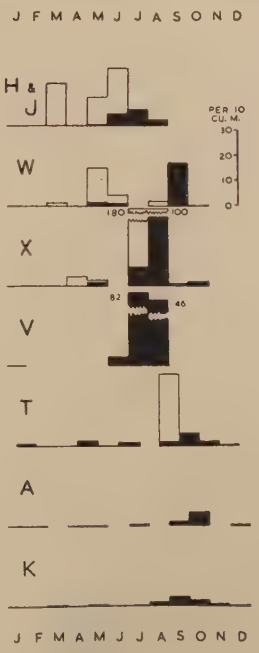


Figure 34.

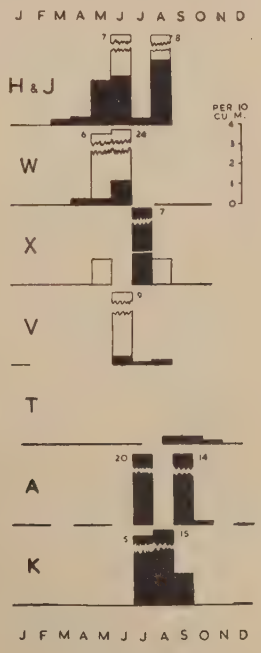


Figure 35.

Figure 34. Histograms representing the relative numbers of *Limacina* (only those individuals larger than 1 mm. included) taken month by month from the Recorder routes H & J, W, X, T, V, A, and K. Details as in Figure 29.

Figure 35. Histograms representing the relative numbers of *Clione* taken month by month on the Recorder routes H & J, W, X, V, T, A, and K. Details as in Figure 29.

sible from these summaries to postulate time successions in the periods of their abundance across the Atlantic routes northwards to the T route and round on to the North Sea routes, A and K. The question of whether such apparent successions were due to the physical transport of the plankton in the Atlantic drift or to a progressive time lag in the occurrence of optimal breeding conditions has had to be left open. It has been suggested, however, that there may be as many as three such successions or waves during any year. The most easily recognisable one has usually been that which started on W in May or June and reached K in August or September at about the time when the Atlantic incursion into the North Sea may be expected to be at its greatest. In 1953 the data appear to be both unusual and confusing in this respect. Superficially, there was for each "indicator form" some lag between the period, or periods, of abundance in the Atlantic and the North Sea but the sequences are far less tidy than in previous years. This may in part be due to the gaps in the monthly sampling.

For example, from past experience, it seems reasonable to infer at least two incursions of *Metridia lucens* into the North Sea during the latter part of 1953, a major one starting in October and a minor one in July or August, but it is not possible to associate these two times with preceding periods of abundance on the Atlantic routes. While there was a well-defined maximum on J in June, numbers on W increased steadily from February up to a pronounced maximum in May.

Limacina (Figure 34) appeared as usual in the autumn on T and on the North Sea routes, A and K. But compared with earlier years it was late in establishing itself in catchable numbers over the deep parts of the Atlantic routes. However, in the coastal waters covered by these lines (included in these histograms this year for the first time) it was abundant somewhat earlier.

Clione was also unusually abundant at the inshore end of the Atlantic lines (Figure 35). However, the striking point about 1953 was the quite unprecedented numbers of young *Clione* taken on A and on the K route, over the Fisher Bank, from July to September. When averaged across the whole tow, the maximum catches have been of the order of 3 or 4 per 10 m.^{3} in most years; only in the autumn of 1948 when 12 per 10 m.^{3} were

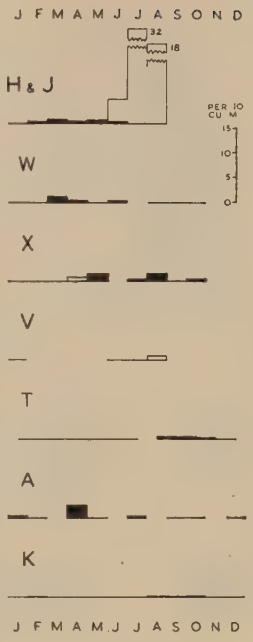


Figure 36.

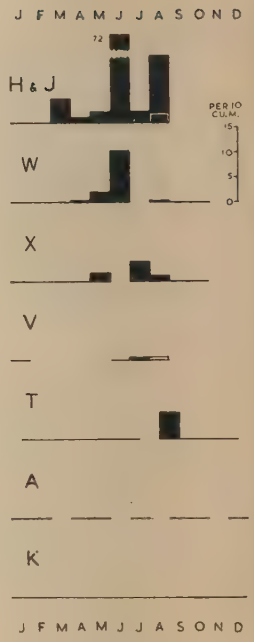


Figure 37.

Figure 36. Histograms representing the relative numbers of *Tomopteris* taken month by month on Recorder routes H & J, W, X, V, T, A, and K. Details as in Figure 29.
Figure 37. Histograms representing the relative numbers of *Thaliacea* taken month by month on Recorder routes H & J, W, X, V, T, A, and K. Details as in Figure 29.

taken on A, were the catches comparable to the 20, 15 and 14 per 10 m.^{3} found in 1953[1]). Young *Clione* were also taken in exceptional numbers in the Plankton Indicator samples on the Scottish herring fishing grounds during July and August and stomach analyses showed that they were eaten in vast quantities by the herring.

Clio, which is not included in the histograms, was taken on W in April and May, on X in May and on V in June.

For *Tomopteris* (Figure 36), 1953 was a poor year. The dense populations usually found over the deeper Atlantic water in May or June were not recorded; the only high numbers were found on T in July and August off the south coast of Ireland. The autumn population in the North Sea was also poor and a concentration found on A in April provided the only catch of note.

[1]) The figure for the number of *Clione* per 10 m.^{3} superimposed on the September 1951, histogram (Ann. Biol., **8**, Figure 10), which appears to read 44, should actually read 4.4.

Thaliacea (Figure 37) had their normal long season in the southern part of the area sampled, and were exceptionally abundant on J in June. They appeared successively later on W and X and had reached V and T by July and late August respectively. Again, as in 1952, the occurrence of *Salpa fusiformis* in August close inshore on the V route near the entrance to the Fair Isle Channel may be noteworthy. If the drift carried salps or doliolids into the North Sea during the autumn, they were not sufficiently abundant at 10 metres to be taken by the Recorder.

Rhincalanus nasutus (not illustrated) was nowhere abundant during 1953. However, it showed the usual south to north time sequence on the Atlantic routes. It was caught from February to August on H and J, from April to August on W and from April to September on X; it did not reach V until August and it was not recorded in the North Sea or on T.

A preliminary view of 1953, based on these broad summaries, suggests the following features in the northern North Sea. We may deduce that during the early months there was an unusually strong Atlantic influence in the area; either through the persistence of the previous autumn stock or because of subsequent recruitment, exceptionally large numbers of *Metridia lucens* were taken at 10 metres until January or February on the A, K, and T routes. Continued recruitment from the north-west would appear the most likely explanation in view of Tait's[1]) conclusion that the intensity of the flow through the Faroe—Shetland Channel had begun to increase again in December, 1952. Further, *Tomopteris*, which was generally scarce during 1953, occurred on A in January and on K in February.

The unusually early but nevertheless extremely vigorous outburst of spring diatoms on the K route in March was also worthy of note.

Indicator forms were not well represented in the North Sea during the spring except for a patch of *Tomopteris* on A in April and a few *Metridia* which might well have been the remains of a population carried in earlier.

The feature of the autumn was undoubtedly the very large numbers of young *Clione* found on the A route and over the eastern part of the K route. In most years adult or near adult *Clione* appear to be carried into the area during the summer or autumn but these concentrations found in 1953 must have been produced by local breeding. This may be taken as indicative of the conditions within the northern part of the North Sea being more similar during the autumn of 1953 to those usually prevailing in the Atlantic. Associated with this may have been the sparse catches of the plankton as a whole taken on the K route during September and October when compared with the rich and varied fauna commonly found at that time of year; a point which was most striking from even a cursory examination of the "silks" although it is not brought out well by the histograms included in this summary.

K. M. Rae.

Zooplankton Collections made by Scottish Research Vessels during 1953.

Short descriptive abstracts of the year's plankton conditions to the west and north-west of the British Isles are given to the Atlantic and North-Western Area Committees. This note refers to conditions in the northern North Sea, chiefly west of 1°E. and in the neighbourhood of the Orkney and Shetland Isles. A more detailed report on the year's survey as a whole is being prepared for submission to the Paris meeting of I.C.E.S.

During the spring *Calanus finmarchicus* was abundant east of Shetland and on the Fladen, and persisted until the early summer, especially in the eastern half of the area and in the bottom layers. By late summer and autumn there was a scarcity of crustaceous plankton in this area and east of the Moray Firth associated with an increase of oceanic species (see below), but towards the end of the year *Calanus* was plentiful off the east Scottish coast especially between 56°N. and 57°30'N. and west of 0°. Often mixed with the *Calanus* were rich collections of small euphausids, mostly *Nyctiphanes couchii*, but also *Thysanoessa inermis*, and *T. raschii*, and large quantities of *Sagitta elegans*, and young *Clione limacina*. *Sagitta setosa* was at times abundant to the SE. of this rich mixture, especially in November and December. *S. serratodentata* was widely, but sparsely, distributed over the whole northern North Sea in spring,

[1]) Ann. Biol., **9**, p. 99, 1954.

Table 6. Some of the Main Characteristics of the Plankton Indicator Distribution round the North of Scotland, 1920—1939 and 1946—1953.

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1946	1947	1948	1949	1950	1951	1952	1953
A	..	..	..	..	..	..	..	..	L	..	..	?	L	L	..	L	..	L	L	..	L	..	..	..	..	..	L	L
B	X X	X	O	O	X X	X	O	O	X	?	O	?	O	O	O	?	X	X	X	X X	O	X X	X X	X	X	O	O	O
C	X X	X X X	X	X X	X	X X X	X X	X	X X X	X	X X	?	X	X X	X	X X	X	X X	X X	X X	X X X	O or X	X X	X X X	X	X X	X X	X X
D	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	A	..	A	..	A	..	..	..	..	..	..
E																												
59°00′	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..
58°30′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..
58°00′	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
57°30′	X	..	..	X	X	X	..	..	..	..	X	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..
57°00′	..	X	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	X	..	..	..	X	X
56°30′	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56°00′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	X	..	..	..	..
55°30′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
55°00′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..
54°30′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
54°00′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..

A Plankton from both the open Atlantic and from the Lusitanian area enters the Faroe Channel. Years in which the Lusitanian forms were more than usually well represented are indicated by 'L'.

B In some years a proportion of the oceanic plankton species pass through the Fair Isle-Orkney passages and affects the Moray Firth area. Degrees of this effect are indicated by O, X or XX.

C The main stream of the oceanic plankton passes the north of Shetland and a branch enters the North Sea east of Shetland to a varying extent, indicated by X, XX or XXX.

D In most years there is some admixture of arctic or boreal plankton in this stream, years where this was marked are indicated by 'A'.

E The degree of penetration of this fauna into the North Sea depends on the persistence of the organisms, which depends on various factors not necessarily solely relative to the total amount of fauna entering. The approximate southern limits are given.

having survived the winter there. By autumn a new contingent occupied the Moray Firth, Fladen and Fair Isle areas, and was mainly confined to the north of 58°N.

In the corresponding report last year, it was stated that an oceanic fauna had persisted until December 1952 in the extreme northern part of the North Sea. It is now known that it persisted even later and was still present in April 1953. By the summer the new oceanic forms had started to appear in the Faroe—Shetland Channel and as stated in the North-Western Area report they contained a much greater proportion of southern — as distinct from western oceanic — species. Medusae such as *Atolla bairdii* and *Rhopalonema velatum* were found near Shetland with *Arachnactes* larvae and other oceanic forms such as *Rhincalanus, Eucalanus elongatus* and *E. crassus, Agalma, Vogtia, Dimophyes arctica* and the salps *S. fusiformis* and *I. asymmetrica*. Large numbers of *Pelagia perla* were present at Shetland, near Fair Isle, west of Orkney and in the North Sea east of 1°W., at times in sufficient numbers to cause inconvenience to fishermen. *Pelagia* largely replaced the usual

Aurelia in these areas. Accompanying the *Pelagia* into the North Sea were a host of exotics. *Salpa fusiformis* reached as far south as 58°N. with *Ihlea asymmetrica, Rhopalonema, Thysanoessa longicaudata, Eucalanus* and *Rhincalanus, Galetta biloba* (= *australis*) was abundant as far as 57°N. with *Agalma* and other siphonophores and with unusual numbers of *Fierasfer* larvae — as many as 5 in an oblique haul with a 1-metre net. The siphonophore *Praya cymbiformis* was found in November east of Fair Isle and a perfect specimen of *Phronima sedentaria*, complete with case, was found a few miles south of this.

Pleurobrachia was very abundant in many coastal areas, particularly in the Moray Firth in July and to the east and south of the oceanic patch in November and December. Very dense collections of *Limacina retroversa* were found off the Firth of Forth towards the end of the year, where *Thysanoessa inermis* had been abundant in the early months.

Although there was distinct evidence of homogeneity between the plankton taken to the immediate east of Orkney and that of the Moray Firth, none of these collections contained oceanic species. The salp *Iasis zonaria* and *Pelagia perla* were found west of Orkney but not east or in the Moray Firth west of 2°W.; indeed *Aurelia* was, as usual, abundant there in July.

No collections were made to the west of the Fair Isle—Shetland passage in autumn but it seems likely that the whole of the autumn influx of oceanic forms came round the north of Shetland, filled the eastern half of the Fair Isle—Sumburgh passage and continued southwards concentrated mostly to the east of 1°W. These species did not themselves penetrate further south than 57°N., but the oceanic effect was seen in the plankton as far as 56°N. It appears to have been associated in October with water containing less than 0.4 μg.atoms PO4/P per litre and a surface temperature of less than about 11.5°C., the "local" patch to the west being over 12°C. By December the non-oceanic patch had cooled to about 9°C. while the oceanic area was still above 10°C.

A table is given on p. 100 which attempts to summarize in a concise form the main features of the oceanic plankton inflow into the North Sea for the period 1920—1954 (excluding war years).

J. H. Fraser.

Zoo- and Phytoplankton of the Flamborough Line, 1950—53.

The Hensen-net results are dealt with here from the Flamborough Line 1950—53. This is in continuation of the results for 1946—49 (Cattley, 1950). From 1951 sampling on the line has been restricted to the months of April to September inclusive so that it has been thought best to represent the results referring to the total numbers of the phytoplankton and of the zooplankton in the form of histograms. For uniformity the year 1950 is treated in the same way. No sampling was carried out in April or August of that year, but the results from March are included to provide extra information. The position of the stations, the Hensen-net used, and the method of its operation have been described fully by Wimpenny (1944). The six stations of the line have been considered together and the average catches per cubic metre are plotted in Figure 38 at their monthly intervals. As the time of sampling is not the same each month, the approximate position in the month when this was carried out is represented by a vertical line through each column.

The zooplankton shows comparable values to those for 1946—49 (Cattley, 1950) and for the period 1933—39 (Wimpenny, 1944). The absence of data for August 1950 makes it a little uncertain in which month the main peak occurred in that year. There was no peak in May which suggests that numbers increased through June to a maximum in July followed by a decrease in August and a secondary peak in September. It should be noted, however, that the samples were taken late in the month in June and September, and particularly late in July. The values referring to the last, therefore, are almost as if they had occurred in early August. The year cannot be likened to that of 1948, however, which had a main peak in August and a secondary peak early in the year in May, as the June and July figures are appreciable—despite the fact that the September figures are similar in the two years. Should the year be comparable in fact to that for 1947 it is evident that the whole production curve took place slightly later than in that year. 1953 has also a main peak in July and a secondary peak in September. 1951 and 1952, however, differ from other years in having the main peak occurring over the June-July period and no secondary peak.

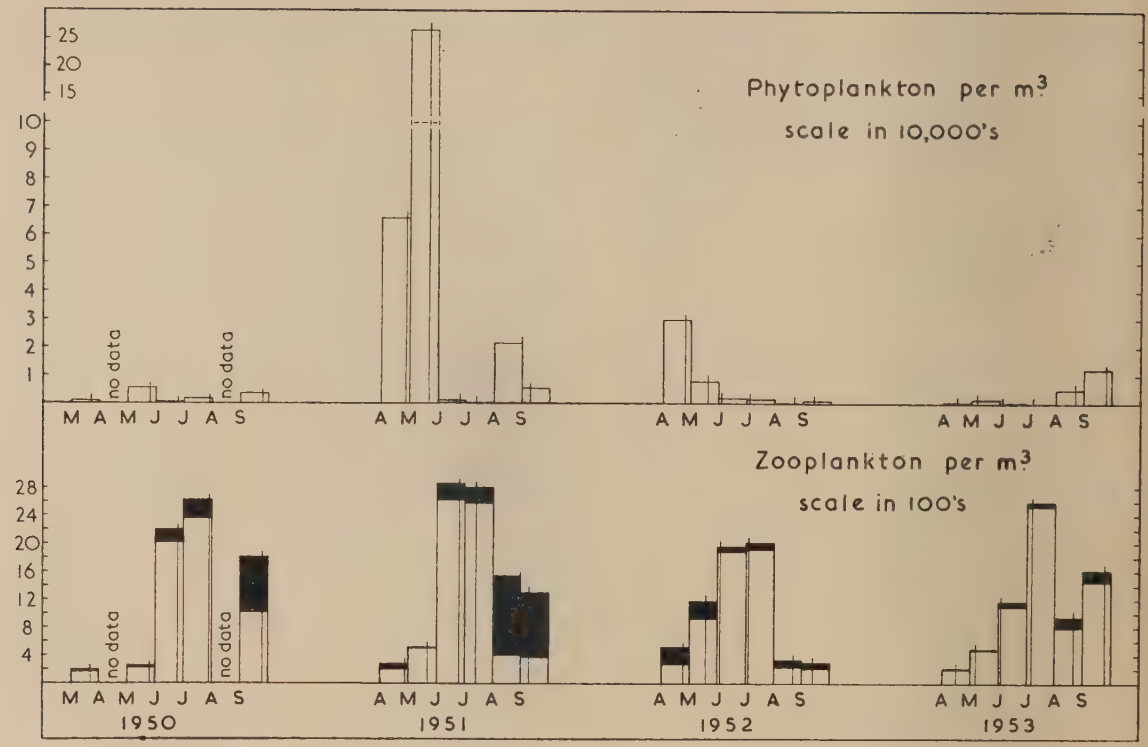


Figure 38. Histograms showing the mean monthly values at six stations between Flamborough Head and the Dogger Bank for Phytoplankton and Zooplankton.

For the four years under consideration the data show that zooplankton production had recovered somewhat in 1950 from the level it had fallen to in 1949; that this level had been maintained in 1951, but had fallen again to the 1949 level in 1952 only to recover to the previous level in 1953.

The solid portion of each column in the histograms represents the numbers of eggs and juvenile stages in the zooplankton in each month so that the lower limit represents the proportion of the adults. In relation to this it should be noted that the practice is continued of including the copepodid stages of the copepods with their adults. The amount of reproduction in September 1950 and in August and September 1951 is particularly noticeable, while the year 1952 stands out as a particularly bad year in this respect and the later part of 1953 is little better.

The numbers of copepods present in the plankton at any time will depend amongst other factors on the number of pelagic fish in the area feeding on them. If these fish are absent when the copepods are actively increasing, their total numbers will be able to reach higher proportions than if this were not the case. The most striking character of the copepod plankton of the line is revealed by a comparison of the numbers of *Calanus* over the periods 1946—49 and 1950—53. In the first period the highest figure recorded was 293 per m.^{3} (May 1948) followed by a secondary peak of 213 per m.^{3} in August of the same year: the next highest figure being 171 per m.^{3} (July 1947). In the second period June 1952 has a peak of 271 per m.^{3} comparable to the highest previous figure but 1950, 1951 and 1953 have peaks far in excess, reaching 500 per m.^{3} in June 1951 and not far short of it in July 1953 and in June of 1950. In respect to 1953 it is to be noted that the numbers of *Calanus* were very low in May.

The figures for the remaining copepods together are not remarkable, showing more or less normal numbers present in the months June—August. All the main peaks appear to have occurred in July.

Cattley (1950) pointed out the striking differences in the standing crop of phytoplankton of the 1947—49 period from those of pre-war years and the conditions which would allow of the maximum outburst in any one year. The conclusions drawn were that in 1947 the standing crop was at a far lower level than in pre-war years, but that from then onwards it had been recovering. The 1950—53 data show that this trend has not been continued. A level above 40,000 per m.^{3} was recorded only in 1951 (April and May), the next highest level being 30,000 per m.^{3} in April 1952. No samples were taken in April 1950 but the March and May levels were very low when the zooplankton was also at a low level. It is extremely improbable, therefore, that the April figure could have been significant. It is evident that 1950, 1952 and especially 1953 are outstanding as the worst years of phytoplankton production in the whole periods 1933—39 and 1947—53. In 1952 it should be noted that the April figure of 532 per m.^{3} for the zooplankton was about twice the average for that month during the period 1947—53, this figure being approached only in 1949 (433 per m.^{3}), so that grazing has probably been responsible for reducing the phytoplankton more in this year than in the others. If the zooplankton level had been normal it is feasible that the phytoplankton standing crop would have been correspondingly greater, although it is unlikely that this would have reached a level comparable to that in April of the previous year.

In 1951 the level of 267,173 per m.^{3} in May is over twice that reached (in the comparable month) in 1949 — the best year of the 1947-49 period. The April figure is also appreciable (65,959 per m.^{3}). Production is in fact more in line with that encountered in the 1933—39 years. The histograms for the year bring out the effect of zooplankton grazing in a remarkable way, and this is also evident to a less extent in 1952.

Previous mention has been made of the extremely complex nature of the currents in the area in which the line of six stations is situated (Cattley, 1950). Observations of surface temperature and salinity being incomplete even in the six-monthly periods April—September, particularly in 1950 and 1951, resource has been made to a single station at 54°05′N., 01°30′E. just south of the line. This is a station on the commercial Hull—Copenhagen route. The mean monthly surface temperature and salinity has been considered for the twelve months of each year, but it is apparent that no useful information in relation to the means of the six stations on the Flamborough Line can be deduced from it. The mean temperature for April of each year at this single station is given below: —

April Mean T°C. at 0m.,
Position 54°05′N., 01°30′E.

1950	1951	1952	1953
7.4	6.0	6.6	7.1

From this it will be seen that the April temperature was lowest in 1951 when the phytoplankton on the Flamborough Line was at its highest production figure for the four years. Next lowest temperature is in 1952 when the phytoplankton level was better than in either 1950 or 1953.

Wimpenny (1953) has dealt with the dry weight and fat weight of the plankton from comparable hauls for the years 1950—52. His conclusion as to the percentage of fat, that the individual values were lower in 1952 than in either 1951 or 1950, is in agreement with the results discussed above. He has shown, however, that the dry weight and fat weight were higher in 1952 than in 1951. These would appear to be in disagreement with the species numbers, and examination of the detailed plankton sheets does not reveal any particular reason for this. The numbers of *Coscinodiscus concinnus* present at stations 3 to 6 inclusive in June 1952 were, however, appreciable, while this large diatom was absent except for a very low number at station 5 in the comparable month of 1951. It may be that the importance of this diatom in these respects has not been fully appreciated and that it may have been a contributory cause of his higher values in 1952—as indeed it appeared to be in May 1948.

J. G. Cattley.

References.

Cattley, J. G. Zoo- and Phytoplankton of the Flamborough Line, 1946—49. Ann. Biol., **6**, pp. 121—123, 1950.

Wimpenny, R. S. Plankton Production between the Yorkshire Coast and the Dogger Bank, 1933—1939. Journ. Mar. Biol. Assoc. U.K., **26**, pp. 1—6, 1944.

Wimpenny, R. S. The Dry-Weight and Fat Content of Plankton with Estimates from Flagellate Counts. Ann. Biol., **9**, pp. 119—122, 1953.

Bottom Investigations.

During 1953 the bottom investigations in the eastern German Bight were continued. The number of samples (van Veen grab, 0.1 m.²) was:—

	Number of stations	Number of samples
Routine observations 8.5.—20.5.	21	42
Routine observations 28.8.— 7.9.	21	42
Additional observations 25.7.—1.8.	9	18

The following statements may be derived from the investigations which, however, have not yet been fully evaluated:—

In general the numbers of benthic animals were in the spring and the autumn of 1953 nearly as high as in 1952. At some stations the stock of lamellibranchs was still less. The thin-shelled *Abra* species could scarcely be found in the 1953 samples, after their maximum (which they shared with various other species) in the autumn of 1950 and in the spring of 1951. *Lunatia nitida* became still more abundant. The number of large specimens of *Pectinaria koreni* was conspicuously high in the samples of the spring of 1953 to the south-east of Helgoland. The length was from 30—40 mm., and up to 40 specimens per 0.1 m.² occurred! In 1953 no *Amphiura filiformis* were found, not even in places where a very high number of these animals was available in former years.

In addition the stomach and intestine contents of about 600 plaice caught on the routine stations were analysed. In several instances of a high abundance of *Pectinaria* this was almost the only food of plaice. As in the bottom samples, the number of *Lunatia nitida* found in the stomachs of plaice increased also compared with the previous years.

E. Ziegelmeier.

THE FISH

Eggs and Larvae.

Observations on Pelagic Fish Fry in the Jade Estuary.

As in former years hauls were made with the Petersen young-fish-trawl in winter and spring. The opening of this gear had only about half the area of the normal net. Once or twice a month the occurrence of fish fry and invertebrate plankton was investigated by one 10-minute haul near the surface and one near the bottom at each of five approximately equidistant stations during the cruises of the shrimper "Seehund" in the Jade deep.

Comparing the plaice data in 1953 with those of previous years (cf. Bückmann, Ann. Biol. **9**, p. 32), it is seen that in the area investigated the larvae occurred about one month later than formerly. This might have been caused by the delay of spawning in spring (see Aurich and Bohl, below, pp. 105—7). The occurrence of a relatively high number of 0-group plaice and—on the other hand—only sporadic young soles in autumn 1953 corresponds with the abundance of plaice and sole larvae in spring and summer shown in Table 7.

Table 7. Number of Pelagic Fish Fry

in five hauls near the surface and five hauls near the bottom, each of 10 minutes duration.

	23.—24. February	1.—11. March	19. March	8.—9. April	21. April
Plaice....	—	2	—	—	58
Flounder .	—	—	—	—	86
Herring...	201	559	1,293	567	647
Anchovy..	—	-	—	—	—
Sole.....	—	—	—	—	—

	8. May	19. May[1])	17. June[2])	22. July
Plaice....	62	138	4	—
Flounder .	1,441	178	—	—
Herring...	62	1	—	—
Anchovy..	—	—	—	1,091
Sole.....	—	—	10	2

[1]) Only 9 hauls.
[2]) Only 7 hauls.

Since August 1953 it has not been possible to continue these investigations. Only a few hauls were analysed in August, but considerable quantities of anchovy larvae, pilchard larvae and young sprats (30—50 mm.) were taken.

A great number of sprat and sole eggs was found in the Jade in 1953. Large samples of these eggs were caught at the end of April and in May, with a maximum of 8,240 eggs of sprat and 870 sole eggs per 10-minute haul of our small Petersen net.

G. Hempel.

Observations on Pelagic Fish Fry in the German Bight.

1. Research vessel "Uthörn".

In order to study the influence of climatic change on the distribution and frequency of pelagic fry and plankton, the research vessel "Uthörn" carried out quantitative vertical sampling with the Hensen net in the southern North Sea (south of 55°N., east of 3°E.): — from 2. to 17. March (40 stations), 8. to 30. May (22 stations) and 19. June to 7. July (59 stations).

Fish eggs and larvae. (Material not yet fully evaluated). Contrary to the conditions during spring and summer no essential changes were found in the winter spawners compared with the pre-war years. On the spawning grounds within the German Bight the density of the cod fry was practically unaltered. For the plaice, however, the figures are essentially higher than in former years with the exception of those of February 1936.

Density of fry on the spawning places of the south-eastern North Sea.

		Average	Maximum	
Cod	February 1936, March 1926, 1937	35—56	116—176	eggs/m.²
	March 1953	75	192	eggs/m.²
	February 1936	75	111—294	eggs/m.²
		4	9	larvae/m.²
Plaice	March 1926, 1935, 1937	4—9	14—35	eggs/m.²
		4—11	15—51	larvae/m.²
	March 1953	47	159	eggs/m.²
		8	12	larvae/m.²
	February 1936		370—821	eggs/m².
Dab	March 1926, 1935, 1937		300—1185	eggs/m.²
	March 1953		300—765	eggs/m.²

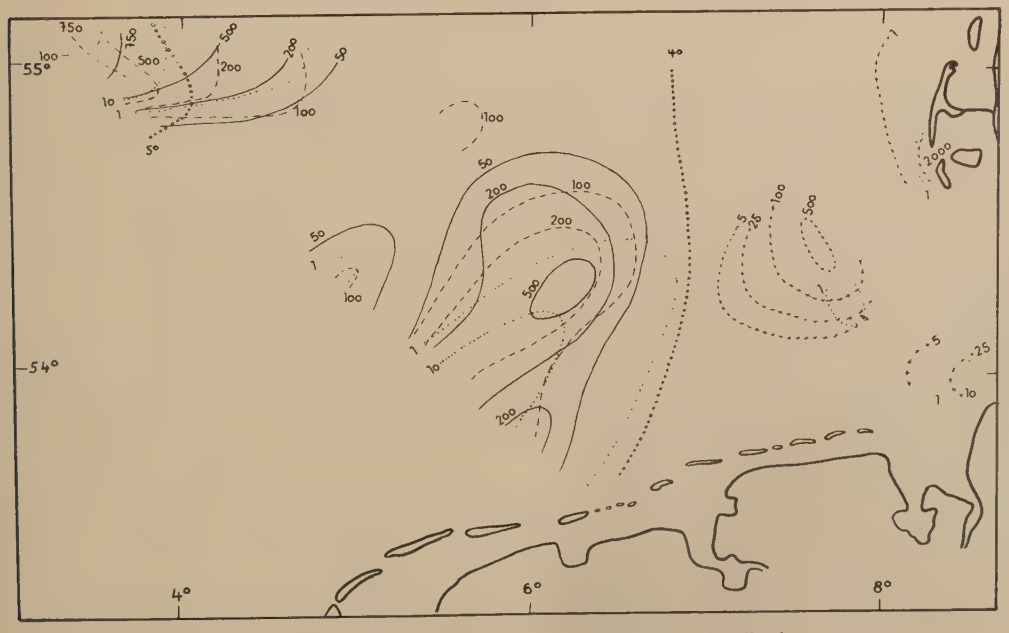


Figure 39. "Uthörn" 2.—17. March 1953. Plankton distribution.

Isoplankts
——— *Chaetoceros atlanticus* Cleve 20, 200, 500, 750 thousand cells/m.²
- - - - - - - *Coscinodiscus concinnus* W. Smith 100, 200, 500, 750 thousand cells/m.²
. . . . . *Biddulphia sinensis* Greville 1, 10, 100 thousand cells/m.²
× × × × *Biddulphia aurita* (Lyngb.) Brébisson & Goday 5, 25, 100, 500, 2000 thousand cells/m.²

Figure 40. "Uthörn" 2.—17. March 1953. Spreading of cod and plaice eggs.

Isoplankts:	————	plaice	10, 25, 100 eggs/m.²
	. . . . .	cod	25, 100 eggs/m.²
Dotted area:		cod	100—192 eggs/m.²

The increased abundance of the plaice fry is not exclusively caused by an increase in the spawning stock. In 1953 the spawning was very much delayed. This is proved by the very small number of larvae in relation to the number of eggs. So in March 1953 the maximum of spawning was just only passed, while in other years it may have occurred as early as the beginning of February.

During March 1953, the distribution of the fry apparently is determined by the warm water of 5°C. and characterized by a strong development of diatoms (*Coscinodiscus concinnus, Chaetoceros* spp., *Biddulphia sinensis*).

Within the German Bight the diatoms are only scanty or represented by other species (*Biddulphia aurita* in the mixing zone off the mouth of the Weser and Elbe and at the coast). (Figures 39 and 40).

The frequency of the plaice eggs attains its maximum within the warm southern water and decreases rapidly towards the north as well as towards the cold coastal water. The eggs of the dab show a similar distribution. The maximum of the cod eggs, however, is found in the mixing area between warm and cold water.

During the spring and summer cruises, the extension and increase of the spawning of the pilchard, anchovy, *Caranx*, and mackerel could again be noticed. To a smaller extent, the sole shows the same phenomenon, whilst the spawning of the dab and of the sprat have not changed in comparison with the pre-war years.

Density of the sole fry in the south-eastern North Sea.

April—June	1902—1937	maximum	10—36	eggs/m.²
May	1949	»	ca. 70	eggs/m.²
May—June	1950	»	45—90	eggs/m.²
May—June	1951	»	150—357	eggs/m.²
May	1953	»	40—51	eggs/m.²

It appears that only the migratory fishes were influenced by the climatic changes within the area investigated, while the indigenous spawning stocks, except the sole, were not influenced.

H. J. Aurich.

Reference.

Aurich, H. J., 1953. "Verbreitung und Laichverhältnisse von Sardelle und Sardine in der südöstlichen Nordsee und ihre Veränderungen als Folge der Klimaänderung." Helgoländer Wiss. Meeresunters., 4.

Figure 41. Distribution of plaice eggs during the cruise of the "Gauss" in March 1953.

2. Research vessel "Gauss".

During the cruise of the "Gauss", carried out in March 1953 in the southern North Sea, the distribution of eggs and larvae of plaice was investigated (Figure 41).

At this time the hydrographic situation was characterized by a large south-eastern extension of the waters of the central North Sea (>34.6‰). The water masses typical of the Channel (>34.6‰) were found only in a limited part of the Southern Bight. In the south-eastern North Sea they were wholly absent.

Just as in 1952 (cf. A. Bückmann, 1953) considerable spawning took place in 1953 within the area between Botney Gut and the western edge of the Oyster Ground in central North Sea waters. In consequence of the frequent northerly winds, however, the eggs and larvae were transported south-eastwards towards the Dutch coast.

The spawning of plaice was very much extended in time because of the low water temperatures.

The large number of eggs in the south-eastern North Sea (maximum 147/m.²) is brought about by the high salinity in this area and by the abundance and age composition of the spawning stock. The peak of the spawning activity was approximately 6 weeks later than in 1936 and 3 weeks later than in 1952.

Extremely large numbers of eggs and larvae were found in the waters of the Channel (maximum 440 eggs at late stages and 188 larvae/m.²). This points to a very big egg production in the Southern Bight about the middle of February. So the spawning in this area was delayed, too.

Hj. Bohl.

Reference.

Bückmann, A., 1953. "Fischbrut und Evertebraten-Großplankton auf der Fahrt der 'Gauß' im Februar-März 1952". Ber. Dtsch. Wiss. Komm. Meeresforschung., N. F., **13**, 2.

Table 8. Age Composition of Haddock Caught by F. R. S. "Explorer" in 1953.

Per 10 Hours Trawling.

Northern Area		North Central Area				Central Area					Moray Firth and Orkney				
Month	All months	Jan./ Mar.	Apr./ June	July/ Sept.	All months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months
Hours trawling	4	28½	7	21½	57	16½	84½	63½	33	197½	16	11	38	13½	78½
Year-Class	Weighted Means				Weighted Means					Weighted Means					Weighted Means
1952	1575	1111	1409	1192	1178	615	5964	4242	3843	4609	16	417	840	632	577
1951	675	626	351	318	476	538	925	366	173	587	378	231	372	444	366
1950	65	10	23	9	11	21	31	12	2	19	15	5	11	24	13
1949	43	9	41	1	10	11	36	3	1	18	12	4	6	10	7
1948	22	1	9	+	2	10	12	1	1	6	5	3	5	7	5
1947 and over	10	—	1	—	—	—	2	—	—	—	—	—	1	—	—
All ages	2390	1757	1834	1520	1677	1195	6970	4624	4020	5239	426	660	1235	1117	968

Month	Firth of Forth Jan./Mar	Apr./June	Oct./Nov.	All months
Hours trawling	5	3	2½	10½
1952	8	2143	2316	1168
1951	118	263	296	202
1950	16	—	—	8
1949	2	—	—	1
1948	—	—	—	—
1947 and over	—	—	—	—
All ages	144	2406	2612	1379

The Western Area was not visited.

Haddock.

Scottish Investigations.

During 1953, the haddock population in the North Sea was sampled by F. R. S. "Explorer". Owing to the requirements of other work, however, the area covered was less representative than in previous years, the bulk of the samples from the "central" area coming from square C13, and those from the "north central" area from square C14.

Age composition.

The age composition of the haddock captured is shown in Table 8. The 1952 and 1951 broods were well distributed throughout all areas sampled and constituted 98 % of the haddock captured. Both broods were sufficiently large to be captured by commercial trawlers (Table 10), but only the 1951 brood was large enough to meet the minimum landing requirements. Older broods were best represented in the northern area, as in previous years.

Table 9. Distribution and Density of the 1953 Brood in "Explorer" Catches, June to November 1953.

Area	No. of fish	No. of hours	Per 10 hrs.
Northern	1	1	10
North Central	293	22½	130
Central	1738	96	181
Moray Firth and Orkney	8	51½	2
Firth of Forth	0	2½	0
Western	—	Not visited	—
Total for all Areas	2040	173½	118

The 1953 brood (Table 9) was only moderately represented in the central and north central areas and may be classed as a "poor-average" brood.

Size composition.

As in previous years, the smallest haddock, age for age, were taken from the northern area. Those from the central and north central areas were somewhat larger, and the largest haddock of all were from the Moray Firth and Orkney areas (Table 10).

Table 10. Mean Lengths (cm.) and Standard Errors of Haddock of each Age-Group from the North Sea — 1953.

Year Class	Age	Month	Northern			North Central			Central			Moray Firth & Orkney			Firth of Forth		
			Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish
1953		June	6.0	—	1	7.5	0.500	2	–		—	—	—	—	—	—	—
	0+	July-Sept.	—	—	—	15.0	0.071	291	—	—	—	—	—	—	—	—	—
		Oct.-Nov.	—	—	—	—	—	—	18.0	0.030	1738	15.2	0.491	8	—	—	—
1952	0+	Jan.-March	—	—	—	18.5	0.024	3167	18.9	0.047	1014	19.7	0.378	26	20.8	0.632	4
	1+	April-June	18.2	0.058	630	17.6	0.050	986	19.6	0.000	50400	21.6	0.065	459	21.9	0.061	643
	1+	July-Sept.	—	—	—	24.5	0.032	2563	21.9	0.010	26934	24.4	0.030	3192	—	—	—
	1+	Oct.-Nov.	—	—	—	—	—	—	26.5	0.014	12681	26.8	0.057	853	26.0	0.081	579
1951	1+	Jan.-March	—	—	—	27.8	0.059	1783	29.5	0.079	888	29.2	0.111	605	29.7	0.277	59
	2+	April-June	25.5	0.131	270	25.7	0.136	246	28.1	0.028	7814	29.8	0.186	254	31.9	0.299	79
	2+	July-Sept.	—	—	—	30.8	0.085	683	29.3	0.050	2325	32.4	0.075	1414	—	—	—
	2+	Oct.-Nov.	—	—	—	—	—	—	33.0	0.107	572	33.7	0.098	599	35.6	0.308	74
1950	2+	Jan.-March	—	—	—	37.5	0.495	28	36.6	0.459	34	42.8	0.846	24	38.8	0.590	8
	3+	April-June	32.0	0.501	26	31.4	1.024	16	36.9	0.150	265	39.0	1.378	5	—	—	—
	3+	July-Sept.	—	—	—	39.0	0.908	19	37.1	0.253	77	40.7	0.463	40	—	—	—
	3+	Oct.-Nov.	—	—	—	—	—	—	40.0	1.278	7	41.1	0.314	33	—	—	—
1949	3+	Jan.-March	—	—	—	41.5	0.927	26	43.2	1.042	18	48.6	1.145	19	46.0	—	1
	4+	April-June	36.1	0.600	17	33.5	0.637	29	40.7	0.197	308	44.5	1.555	4	—	—	—
	4+	July-Sept.	—	—	—	45.3	3.528	3	41.6	0.560	22	45.2	1.018	21	—	—	—
	4+	Oct.-Nov.	—	—	—	—	—	—	47.0	3.000	2	46.4	0.775	14	—	—	—
1948	4+	Jan.-March	—	—	—	56.5	3.500	2	46.1	1.162	16	52.4	1.973	8	—	—	—
	5+	April-June	41.6	1.303	9	41.2	1.222	6	44.5	0.469	102	47.3	6.010	3	—	—	—
	5+	July-Sept.	—	—	—	45.0	—	1	49.3	1.542	6	51.5	1.049	18	—	—	—
	5+	Oct.-Nov.	—	—	—	—	—	—	45.5	1.500	2	50.3	1.333	9	—	—	—
1947	5+	Jan.-March	—	—	—	—	-	—	—	—	—	—	—	-	—	—	—
	6+	April-June	42.2	2.927	4	46.0	—	1	56.8	1.637	13	—	—	—	—	—	-
	6+	July-Sept.	—	—	—	—	—	—	—	—	—	56.0	5.000	2	—	—	—
	6+	Oct.-Nov.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 11. Landings of Haddock by British Steam Trawlers from North Sea in 1953.

Quarterly Period	North of Lat. 57°30′N. Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	Lat. 55°N. to 57°30′N. Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	South of Lat. 55°00′N. Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	All Areas[1]) Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.
Jan.-March	449	667	67	156	273	57	11	1545	0.7	775	2721	28
April-June	462	619	75	359	719	50	60	1007	6	966	2459	39
July-Sept.	390	424	92	475	878	54	129	854	15	1197	2347	51
Oct.-Dec.	493	439	112	654	698	94	138	1174	13	1457	2460	59

[1]) Includes landings from unknown rectangles.

Commercial fishery.

During 1953 there was a decrease in the landings and catch-per-unit effort from all areas combined during the first six months, but an increase thereafter. This trend was also shown by the landings from north of latitude 57°30′N. whereas an opposite tendency was shown by those from latitudes 55° to 57°30′N.

R. Jones, W. Main.

Table 12. Landings of Whiting by British Steam Trawlers from North Sea in 1953.

Quarterly Period	North of Lat. 57°30′N. Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	Lat. 55°N. to 57°30′N. Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	South of Lat. 55°00′N. Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	All Areas[1] Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.
Jan.-March	840	667	125	82	273	30	82	1545	5	1268	2721	46
April-June	796	619	128	189	719	26	40	1007	4	1131	2459	45
July-Sept.	257	424	61	189	878	22	83	854	10	648	2347	28
Oct.-Dec.	474	439	108	243	698	35	86	1174	7	894	2460	36
Year	2367	2149	110	703	2568	27	291	4580	6	3941	9987	39

[1]) Includes landings from unknown rectangles.

Whiting.

British Statistics.

The data in Table 12 are presented as a summary of the landings by British steam trawlers in 1953. As in previous years they are set out in the form adopted for haddock, Ann. Biol. **6.** A comparison of these data with those published in the previous volume of this publication shows that there was a tendency for both landings and catch per unit from all North Sea areas to be a little lower than in 1952.

R. Jones, W. Main.

Plaice.

English Landings in 1952 and 1953.

During 1953 the routine sampling of plaice landings at Lowestoft and Grimsby for length and age determination was continued. Some 170,000 fish were measured, and 3,600 age determinations made. The main results are summarized in Tables 13 and 14.

Table 13 shows the length composition of the landings at the two ports for the biological year April 1953 to March 1954, with that of the previous year as comparison. The Lowestoft length composition has been converted

Table 13. Landings of Plaice at Lowestoft and Grimsby.

Numbers (in thousands of fish) and percentage in each 5-cm. length-group.

Length-Group (cm.)	Lowestoft 1952—53 '000s	%	Grimsby 1952—53 '000s	%	Lowestoft 1953—54 '000s	%	Grimsby 1953—54 '000s	%
20—24	51	0.2	1	0.0	39	0.2	1	0.0
25—29	9,709	41.5	2,410	13.6	7,978	36.4	1,487	10.0
30—34	9,259	39.6	7,231	40.6	9,143	41.8	5,523	37.2
35—39	2,849	12.2	4,691	26.4	3,058	14.0	4,365	29.4
40—44	953	4.1	2,087	11.7	1,049	4.8	1,997	13.5
45—49	386	1.7	801	4.5	437	2.0	887	6.0
50—54	126	0.5	366	2.1	131	0.6	387	2.6
55—59	45	0.2	165	0.9	48	0.2	150	1.0
60 +	10	0	38	0.2	11	0.1	39	0.3
Total	23,389		17,790		21,893		14,837	
Wt. landed '000 cwt.	136.0		156.1		133.7		136.1	
'000 hours fishing	305.7		351.4		280.8		349.6	

Table 14. Number of Plaice of each Age caught by Lowestoft Steam and Motor Trawlers per 100 Hours Fishing.

Age	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
1949—50	59	1,322	3,793	1,135	365	143	124	71	86	63	90	7,251
1950—51	39	929	2,320	1,722	389	198	93	95	81	57	94	6,017
1951—52	91	559	2,576	2,055	982	261	152	71	57	60	87	6,960
1952—53	142	999	1,424	2,828	1,309	519	123	106	61	40	99	7,650
1953—54	57	865	1,900	1,505	1,890	773	406	129	78	53	141	7,797

by use of an age-length key into an age composition, and this is shown in Table 14 in the form of the numbers of fish caught per 100 hours fishing. The figures for the four previous years are also shown for comparison. The mortality rates have continued to be appreciably lower than before the war, some 60—70% of fish surviving from one year to the next, compared with less than 50 % in 1938.

J. A. Gulland.

The Stock of Plaice off Esbjerg and the Danish Plaice Fishery in the North Sea.

The stock of plaice off Esbjerg.

Quantitative fishing was carried out from the research cutter "Jens Væver" in June at twenty stations in the southern Horns Reef area. The average number per hour caught by the 50-foot otter-trawl with fine-meshed cod-end was as follows: —

Depth-zone, m.	5—10	10—20	20—30	30—55
No. per hour	603	493	274	1

In Table 15 the numbers of plaice caught per hour in the 5—10 m. and 10—30 m. depth-zones are compared with the numbers found in previous years. It appears that 4-year-old plaice and older were very scarce. The rich year-class 1947 (the III-group in 1950 and the IV-group in 1951) constituted 15 % of the stock in October 1952 but by June 1953 it had almost totally disappeared from these grounds. The year-class 1952 was rich, as was also found in the quantitative fishing by motorboat in the Danish Waddensea in 1952 (see Ursin, in Ann. Biol. **9**, p. 132). The year-class 1950 was also found to be rich, during the investigations in the Waddensea in 1950, when it was 0-group (see Tåning, in Ann. Biol. **7**, p. 92). However, from Table 16 it is seen that this year-class was not found in very great quantities in the Horns Reef area in 1953 when it was three years old, and we cannot expect that this year-class will contribute any great improvement to the catches.

Table 16. Length Composition of Plaice over 27 cm. Length in Danish Catches in 1952 and 1953 (‰).

Area:	B4, 20—30 m.		C2, NE.		Dogger	
Year:	1952	1953	1952	1953	1952	1953
Months:	June-Nov.	June-Oct.	May-Nov.	June-Aug.	May-Aug.	June-Oct.
No. of catches	6	3	29	12	15	11
cm.-group						
27—30.....	859	871	665	513	340	199
31—34.....	131	118	247	360	331	309
35—39.....	4	11	49	83	220	258
40—44.....	1	0	26	18	58	132
45—49.....	2	0	10	15	27	76
> 50.....	3	0	3	11	24	26

The Danish plaice fishery.

Density of the stock.

The total weights of plaice were noted in the landings measured on the market. The mean weights in tons were as follows (number of landings in brackets, map of area in Ann. Biol., **4**, p. 101): —

		1950	1951	1952	1953
B 4	June-Oct.	3.3 (3)	—	5.5 (6)	4.7 (3)
B 5	May-Oct.	—	4.3 (9)	—	3.0 (7)
C2, N.E.	Aug.-Oct.	4.6 (6)	5.2 (10)	6.2 (18)	4.7 (7)
C2, N.W.	August	4.6 (5)	—	6.0 (4)	6.4 (9)
Dogger	May-Oct.	2.7 (5)	3.3(9)	3.3 (14)	4.2 (12)

Table 15. Number of Plaice caught per Hour with the 50-foot Otter-Trawl in the Southern Horns Reef Area in June 1953,

compared with previous years.

		Length-groups, between 5 and 35 cm.						
Depth	Year	5-9	10-14	15-19	20-24	25-29	30-34	Total
5-10 m.	1950	61	85	79	5	—	—	230
»	1951	186	295	350	91	7	—	929
»	1953	357	83	109	49	5	—	603
10-30 m.	1934-39	84	130	98	48	13	1	374
»	1950	14	79	250	93	26	2	464
»	1951	6	55	87	54	11	2	215
»	1953	118	86	67	59	14	3	347

		Age-groups I—VII +						
Depth	Year	I	II	III	IV	V	VI	VII+
5-10 m.	1950	69	83	89	2	—	—	—
»	1951	216	419	135	168	6	1	—
»	1953	432	77	89	5	—	0.3	—
10-30 m.	1934-39	132	150	53	14	10	15	2
»	1950	25	109	284	45	2	—	—
»	1951	11	79	56	62	7	1	1
»	1953	199	40	87	14	3	3	0.2

The stock had improved from 1950 to 1952 in the areas to the south-east and east of the Dogger. It seems that in the easternmost of these grounds the stock has been less dense in 1953, but that the improvement has continued at the more westerly grounds. The decline must be due to the disappearance of the rich year-class 1947. The improvement in C2, N.W., the Bløden Ground area, is no doubt partially due to the fact that the Danish plaice fishery has been carried out to a smaller degree since the starting of the herring fishery at the Bløden Ground.

Length composition of catches.

On all the grounds to the east and south-east of the Dogger Bank an increase in the length of plaice caught was found on the inshore grounds (B4, 20—30 m.), but it has continued to decrease on the more distant grounds (C2, N.E. and the Dogger Bank) see Table 16.

Attention has been called to the fact (Ann. Biol. 9, p. 131) that this shifting of the length distribution towards greater lengths must be due partly to the relatively poor year-classes 1948—49, following after the rich year-class 1947, and partly to a diminished fishing for plaice arising from the lively participation of the cutters in the herring fishery over the Bløden Ground.

Aage J. C. Jensen.

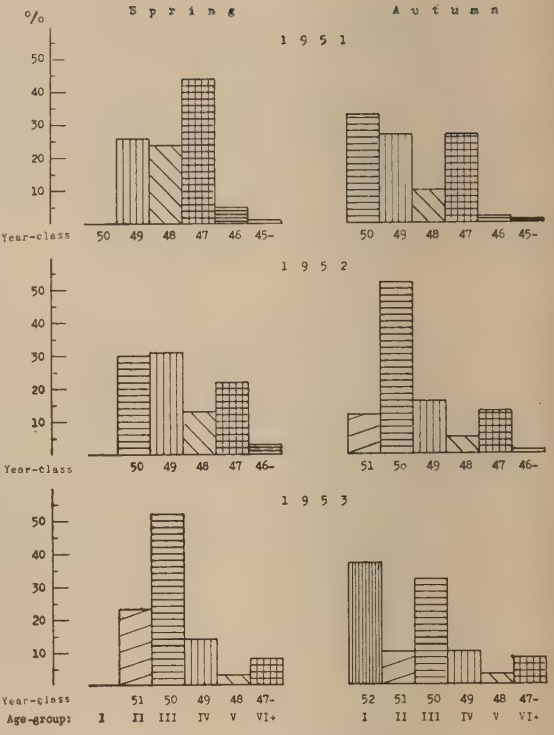


Figure 42. Percentage of the single age-groups in the German catches 1951 to 1953.

The German Plaice Investigations in 1953.

The regular investigations of the "Biologische Anstalt Helgoland" on the plaice stock of the German Bight were continued in 1953 on two cruises of the research vessel "Uthörn" (1st cruise: 8.5—20.5. 2nd cruise: 27.8—9.9.53). Moreover a further cruise was started in order to investigate the plaice population on the fishing grounds of the cutters.

Regarding the method of fishing and the treatment of the material there has been no change from the previous years. The catches were converted into 'Decksteert'—(covered cod-end) catches for comparison with the pre-war investigations (see Ann. Biol. 9).

1. Age composition. (Figure 42).

In spring 1953 the age composition of the plaice population in the German Bight did not differ essentially from that of the autumn 1952. We only noted, that year-class 1947 had somewhat decreased whilst year-class 1950 had little increased. The renewal of the stock, started in 1952 by the entering of the brood of the year-class 1950 in the stock, became much more evident. In autumn 1953 the stock was still younger. The young fishes of the age-groups I to III formed 80 % of the catches, age-group I, 37 %. The predominance of the younger year-classes does not warrant better commercial catches for the next few years as the absolute abundance of these year-classes is very low.

The age composition in the catches from spring and autumn 1953 is given in the figures below: —

Age-group:	I	II	III	IV	V	VI+	Total
Year-class:	1952	1951	1950	1949	1948	1947—	
Spring....	—	23	52	14	3	8 %	3,678
Autumn..	37	10	32	10	5	8 %	2,946

Age-group VI+, for the largest part composed of the rich 1947 year-class (7 of a total of 8 %) was represented in relatively great numbers in spring as well as in autumn, a fact of great importance for commercial fishing.

2. Growth. (Figure 43).

The good growth, established in 1952, continued in 1953. In some cases it was still better. The average length reached or even exceeded the post-war maximum of 1948 (see below). Only year-class 1947 did not reach the high figures of 1948.

The average lengths of the age-groups in the catches from spring and autumn 1948 and 1953 were as follows: —

Age-group:	II	III	IV	V	VI
Spring 1948....	19.7	21.1	23.9	26.1	28.2 cm.
Spring 1953....	17.5	21.1	24.8	26.6	27.0 cm.
Autumn 1948....	21.0	23.4	25.8	29.4	30.1 cm.
Autumn 1953....	21.0	24.1	26.2	27.8	28.5 cm.

This relatively good growth seems to be connected directly with the decrease of the density of the stock, by which the competition for food was diminished. On the other hand especially in 1952, more food was available than in previous years. This is shown by the investigations of the bottom animals by Dr. ZIEGELMEIER.

3. Density of stock and relative strength of the year-classes. (Figure 44).

The decrease of density in the plaice stock, beginning in autumn 1952, went on in 1953 (see below). Whilst in the autumn of 1952 the catch per hour still amounted to 469 fishes,

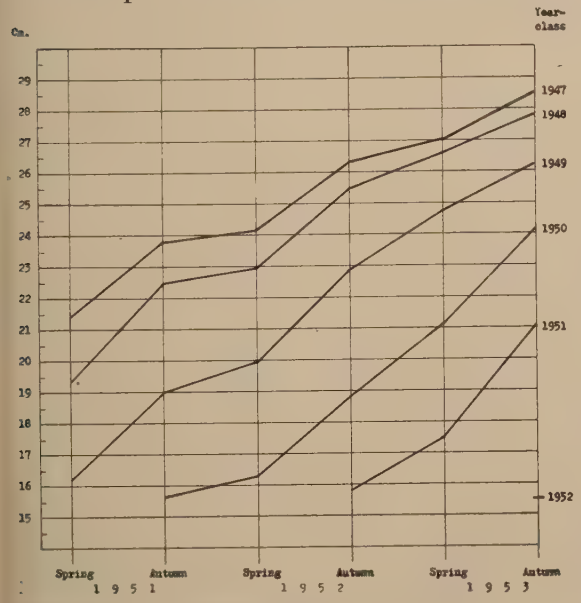


Figure 43. Average length of the single year-classes in 1951 to 1953.

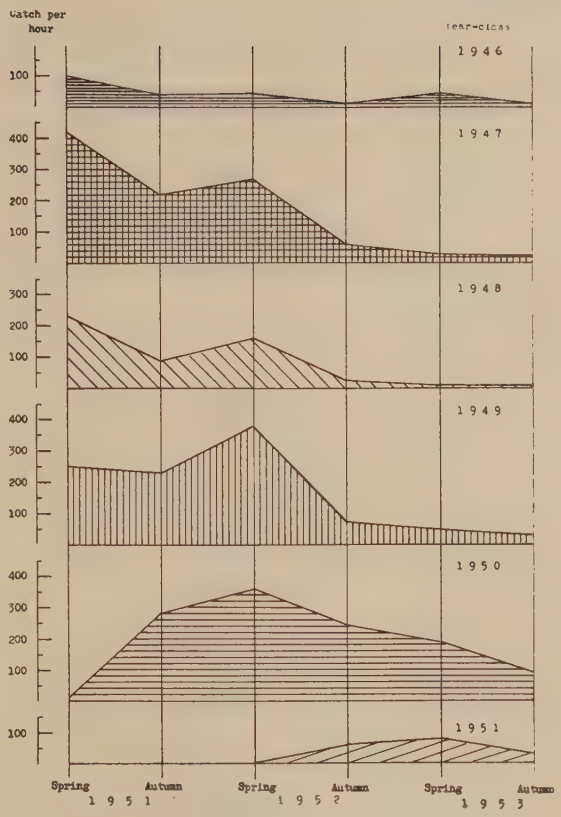


Figure 44. Ratio of the single year-classes in the catch per hour from 1951 to 1953.

it decreased in spring 1953 to 368 and in autumn 1953 to 295 only, which is still below the minimum of the autumn of 1948 (305 fishes). This development may still continue in 1954; up to the present no successful brood has been found. All year-classes decreased in numbers, especially that of 1950, as shown in Figure 44 and the following values, giving the catch per hour in the various age-groups in spring and autumn 1953: —

Age-group:	I	II	III	IV	V	VI +	Mean catch
Year-class:	1952	1951	1950	1949	1948	1947 —	per hour
Spring....	—	84	192	51	12	29	368
Autumn..	110	30	94	28	8	25	295

In the report for the year 1952 an estimate of the relative strength of the single year-classes from their abundances in the II- and III-groups was attempted.

Year-class	1946	1947	1948	1949
	27	100	28	43

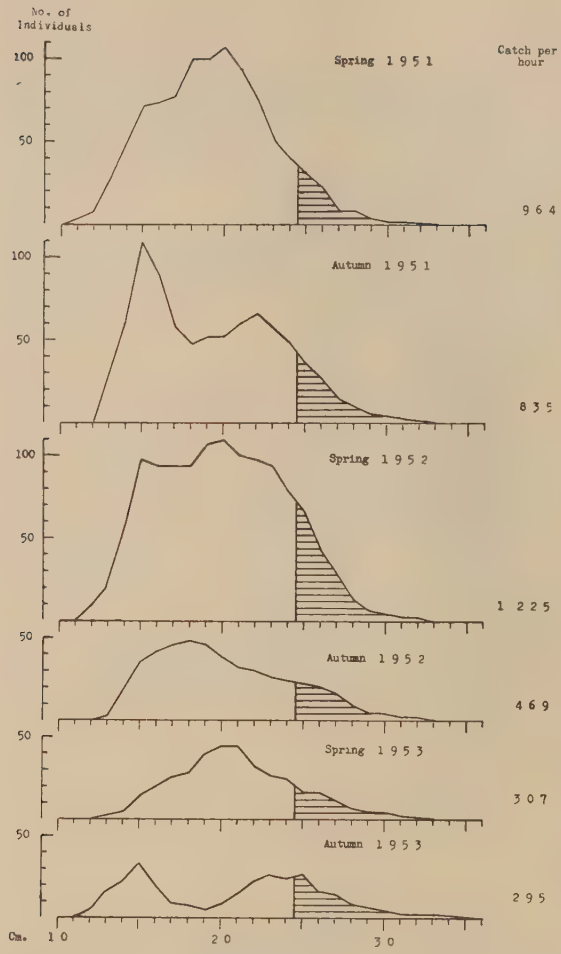


Figure 45. Length distribution of a catch per hour from 1951 to 1953.

To this series we now may add the year-class 1950 with the relative abundance of 40. No definitive statement for the younger age-groups is possible but the year-class 1951 seems to be the poorest since 1947.

4. Length distribution. (Figure 45).

Generally speaking the plaice were nearly 1 cm. longer in 1953 than in 1952. As shown below in spring 1953 17 % of the plaice were marketable fish of 25 cm. and above, which was the same as in autumn 1952. In the course of the summer this percentage increased to 28. This extremely high value is caused by the rich year-class 1947, the badly grown individuals of this year-class therefore still dominated the catches. However, 10 % of the individuals of the 1947 year-class are still below 25 cm. in length.

The percentage of fishes of more than 25 cm. in the catches of the year 1953 was as follows:—

Marketable fishes in the catches.

Age-group:	I	II	III	IV	V	VI	VII+	Total
Year-class:	1952	1951	1950	1949	1948	1947	1946—	
Spring....	0	0	4	44	72	79	96	17 %
Autumn..	0	4	34	70	80	90	100	28 %

The weight of the stock has not decreased along with the number. On the contrary there was some increase:—

		Catch per hour		above 25 cm.	
		number	kg.	number	kg.
Autumn	1952	469	43.3	80	16.0
Spring	1953	368	37.1	61	12.3
Autumn	1953	295	32.1	82	17.0

A. Kotthaus.

Scottish Investigations, Firth of Clyde, 1952—53.

Records of plaice caught in 1951 by the Scottish Marine Biological (Millport) Station's vessel "Calanus" in the inner Firth of Clyde (between the islands of Cumbrae and Bute) suggested the existence of a little-exploited local stock. Through the courtesy of the Director of the Millport Station, facilities were provided for the Marine Laboratory (Scottish Home Department) to sample the stock quarterly during 1952—53. Trawl samples of two hours' duration, using a 30 ft. VD. trawl, were carried out in January, April, July and October of each year; depths ranged from 37—70 m.

The length, age and maturity data obtained are summarized in Table 17.

Size composition. The main size-frequency characteristics were almost identical in both years, covering a wide and, for the most part, high range within the extremes 20—58 cm., with medium-size fish of 30—40 cm. constituting over 60 % of the population. Quarterly results indicated that the population was not a static one but was subject to seasonal quantitative change, maximum numbers occurring in October-January, declining through April to a minimum in July and recovering the following autumn—winter. Observations on maturity suggested that this feature was associated with spawning migration.

Table 17. Plaice: Firth of Clyde, 1952—53.

Size composition

	cm.	20	21—25	26—30	31—35	36—40	41—45	46—50	over 50	Total	Extremes
1952	No.	1	10	86	169	129	55	26	6	482	20—58 cm.
	%	(0.2)	(2.1)	(17.8)	(35.1)	(26.8)	(11.4)	(5.4)	(1.2)		
1953	No.	1	14	67	166	127	63	21	5	467	20—54 cm.
	%	(0.2)	(3.0)	(14.6)	(35.7)	(27.3)	(13.6)	(4.5)	(1.1)		

Age composition

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII-XVI	Total
1952	No.	5	36	160	32	60	49	35	18	17	13	46	11	482
	%	(1.0)	(7.5)	(33.2)	(6.6)	(12.5)	(10.2)	(7.3)	(3.7)	(3.5)	(2.7)	(9.5)	(2.3)	
	Year-class	1951	50	49	48	47	46	45	44	43	42	41	40—35	
1953	No.	—	20	106	152	21	48	45	27	13	13	5	15	465
	%	—	(4.3)	(22.8)	(32.7)	(4.5)	(10.3)	(9.7)	(5.8)	(2.8)	(2.8)	(1.1)	(3.2)	
	Year-class	—	1951	50	49	48	47	46	45	44	43	42	41—37	

Mean size (Oct.-Jan.) ♂ : ♀

Age-group	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+
♂	22.2	29.1	33.1	33.9	34.9	35.7	35.9	35.4	32.7	35.7	—	—
♀	23.4	30.1	35.3	37.1	38.6	39.0	41.0	43.1	43.1	43.9	47.3	49.2 cm.

Age composition. The size range was reflected in the age-structure; this comprised sixteen different broods — those of 1951—35 (age-groups I to XVI). The 1949 year-class, as group III in 1952 and group IV in 1953, dominated to the extent of 33 % in both years, the younger 1950 year-class appearing as a secondary dominant (23 %) in 1953. Lesser dominants were 1947 and 1941, the latter being particularly outstanding in its relatively strong representation as eleven-year-old fish in 1952; it was still appreciable in the following year.

Only one weak brood occurred—that of 1948—which suggests that the area is not subject to violent fluctuations in recruitment.

Growth. The mean sizes of the successive age-groups during the months of suspended growth (October-January) are given in the Table.

Maturities. All stages covering the full cycle from immature to spent condition were caught. As might be expected, however, from the size and age compositions, the population consisted predominantly of maturing or mature fish, 75 % of all plaice caught during the period being at Stages III—VII. Advanced ripening to spawning stages occurred in significant numbers as early as October, while individuals were found in like condition as late as July, thus postulating an extensive spawning season. The season appeared to be later in 1952 than in 1953, extending in the former year from the end of October to July and from October to beyond April in 1953. Although the stock followed through the two years was unquestionably a spawning one, the seasonal decline in numbers suggested a large-scale exodus during spring-summer, so that there are doubts as to whether the Cumbrae—Bute locality is a spawning ground. An attempt to establish this point by a series of tagging experiments was begun in January 1954.

J. M. Lamont.

Young Plaice in the Danish Waddensea 1953.

A total of 132 hauls each of 15 minutes' duration is available from late June, late August, and late October. The modified Petersen young-fish-trawl was used.

86 hauls were carried out in the northern part of the area from Ho Bay to Knude Deep. Here, the number of 0-group plaice was below average: 150 per hour against an average of 201 for the years 1935—53. However, the numbers varied very much from one month to another (June, 48; August, 324; October, 74) so that it is at present impossible to estimate the relative strength of the 1953 year-class.

The 1952 year-class, which was above normal as 0-group, was still so as I-group:— 200 per hour against an average of 173 for

the I-group in 1935—53. The 1951 year-class (the II-group) had almost disappeared from the nursery grounds. As mentioned in Ann. Biol. **8**, p. 111, and **9**, p. 132, this year-class was also previously scarce in the Danish Waddensea. It was known to be scarce in Dutch waters too, and according to BÜCKMANN (Ann. Biol., **9**, p. 136) it was also weak in the German Waddensea. Even in Scottish inshore waters it is but sparsely represented (RAE & LAMONT, Ann. Biol., **9**, p. 136).

From the Rømø area 41 hauls are available. The number of plaice was below the corresponding numbers for the northern area: — 76 0-group and 52 I-group per hour. Material for comparison from the preceding years is not available.

Very low numbers were obtained in 5 hauls off Højer, immediately north of the German border-line (June and October):— 13 0-group and 4 I-group per hour.

The occurrence of a false winter-ring within the first summer zone of the otoliths was observed in a high proportion of the 0-group plaice in 1953. The reading of otoliths was therefore very difficult. However, the length distribution showed very convincingly the point of division between groups 0 and I.

ERIK URSIN.

The Abundance of young Plaice in the Waddensea Area between Weser and Langeoog.

In continuation of former investigations hauls were made in July and September 1953 in the Jade and in the Waddensea area between Jade and Langeoog. The fishing was carried out with the Johansen young-plaice trawl in the depth zone of 1—3 m., in all places where bottom conditions permitted. The total duration of fishing was 11 hours in July and 9 hours in September. In the Jade a rich 1953 year-class of plaice was found in July, but the numbers had decreased already in September. The catch of 0-group plaice per 30 minutes' haul in different parts of the area is shown in Figure 46. Only insignificant numbers of 0-group sole were taken (2 in July, 19 in September).

The specimens of the 0-group plaice were relatively small. This may be caused by the late spawning in 1953. Table 18 represents the average length of the young plaice taken from 1949 onwards. The mean values of 1949—1952

Table 18. Average length (mm.) of 0-Group Plaice.

District/Year	1949	1950	1951	1952	1953
July					
Total.....	51	55	61	47	41
Jade.....	50	55	60	46	41
No. of fish..	831	2771	470	1721	1735
Wang./Lang.	51	58	67	58	48
No. of fish..	378	394	119	121	135
August-October					
Total.....	57	69	88	65	57
Jade.....	55	67	88	64	56
No. of fish..	308	1919	192	208	133
Wang./Lang.	68	77	87	71	63
No. of fish..	62	475	5	38	30

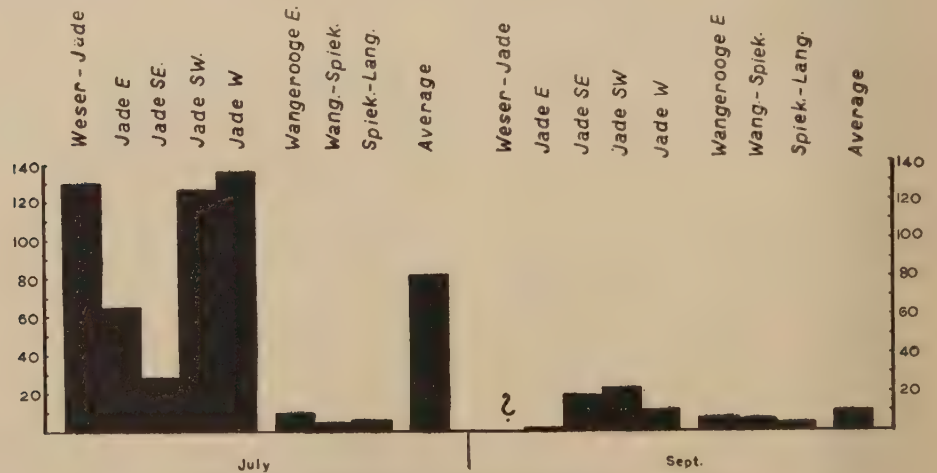


Figure 46. 0-group plaice, catch in 30′ with the Johansen net.

for the whole area differ from those of Ann. Biol. **9** as a better way of averaging was used. It might be recorded in addition that the average length of the 0-group plaice generally was greater in the Wangerooge to Langeoog area than in the Jade. The only exception is the very small sample of September 1951.

G. Hempel.

Rare Fishes.

Scotland.

The following are the records of rare or uncommon fishes landed in Scotland from the North Sea and western grounds in 1953.

Hexanchus griseus (Gmelin)—six-gilled shark, 1; Rockall Bank VIII.

Scymniorhinus lichia (Bonnaterre)—1; Shetland VII.

Squatina squatina (L.)—angel fish, 4; 1 no details, 1 N. Minch VI, 2 N. coast V, XII.

Torpedo nobiliana, Bonaparte—electric ray, 2; Moray Firth III, N. coast XII.

Trygon pastinaca (L.)—sting ray, 1; Largo Bay VII.

Myliobatis aquila (L.)—eagle ray, 2; N. coast XI.

Chimaera monstrosa, L.—rabbit fish or chimaera, 1; St. Kilda XI.

Acipenser sturio, L.—sturgeon, 10; 6 Moray Firth I (2), II, V, VI, VIII, 1 Fair Isle I, 1 Shetland III, 1 W. coast IV, 1 N. coast VII.

Alepocephalus giardi, Koehler—1; Butt of Lewis IV.

Alosa alosa (L.)—allis shad, 1; Firth of Clyde I.

Sardina pilchardus—pilchard, 3 records; 1 Inverness Firth, small numbers Firth of Forth, 4 cwt. Montrose all in XII.

Engraulis encrasicholus (L.)—anchovy, 2; off Buchanness XI.

Scomberesox saurus (Walbaum)—saury pike, 5 records; 1 Orkney I, 2 Shetland III, X, 1 N. of Scotland IX, several Inverness Firth XI.

Belone belone (L.)—garfish, 9 records; 3 records including several fish Coral Bank region of N. Sea IV, 1 E. of Moray Firth X, 3 records off Scottish east coast XI(2), XII(1), 2 records N. Minch XII.

Lampris luna (Gmelin)—opah 1; Flugga VIII.

Trachypterus arcticus (Brünnich)—deal fish, 3; 1 Orkney II, 1 Orkney X, 1 Shetland XI.

Polyprion americanum (Schneider)—stone basse, 1; Rockall Bank X.

Brama rayi (Bloch)—Ray's bream, 9 records; 1 Shetland II, 3 including 9 fish from Butt of Lewis to Shetland X, 1 off Rattray XI, 1 St. Kilda XI, 1 Sule Skerry XI, 1 stranded Firth of Forth XI, 1 SSE. Aberdeen XII.

Mullus surmuletus, L.—red mullet, 20; 15 N. Sea south of Aberdeen, V(1), IX(2), X(4), XI(7), XII(1), 2 N. Sea north of Aberdeen XII, 3 off N. coast of Scotland VI, VII, XI.

Box boops (L.)—bogue, 1; Firth of Clyde II.

Aphanopus carbo, Lowe—black scabbard fish, 2 Butt of Lewis IV.

Fierasfer dentatus, Cuvier—pearl-fish, 1 St. Kilda VIII.

Centrolophus niger (Gmelin)—black-fish, 1 Sule Skerry XI.

Mugil chelo, Cuvier—thick-lipped grey mullet, 2; 1 Caithness III, 1 Shetland VIII.

These records are dealt with in greater detail in a short paper to be published in the *Scottish Naturalist*. A few similar records are also listed under the North-Western Area.

B. B. Rae, E. Wilson.

Germany.

Landed from the North Sea and eastern Channel:—

Species		Date	Locality
1. *Alopias vulpes*, Gml.			
a) ♀ 4.5 m.,	caught	22.9.53	on SW. Spit
b) ♂ 4.2 m.,	»	2.10.53	on Bolders Bank
c) ♂ 4.9 m.,	»	20.10.53	on Dogger Bank.
2. *Myliobatis aquila*, L.			
♀ 90 cm.	»	11.1.53	off Fécamp.
3. *Brama rayi* Bloch.			
a) 5 specimens	»	7.1.53	"Finkenwärder-allee" (northern North Sea) ca. 60°N. 3°E.
b) 55 cm.	»	2.2.53	edge of the Norwegian Deep about 60°N.
4. *Mugil capito* Cuv.			
♂ 57 cm.	»	19.2.53	Oyster Ground.
5. *Morone labrax* L.			
27 cm.	»	14.6.53	10 miles N. of Spiekeroog.

A. Kotthaus.

Transition Area.

INTRODUCTION

Contributions have been received from A. Dannevig, A. J. C. Jensen, I. Bohus Jensen, N. Jerlov, J. B. Kirkegaard, J. Knudsen, R. Kändler, Birger Rasmussen and H. Thomsen.

A. Environment.

Hydrography. Relatively high air temperatures during spring and the first part of summer and autumn gave rise to surface temperatures above normal in March-July and October-December. The outflow from the Baltic was unusually strong in June due to the fairly calm weather during this month when the outflow is normally hampered by the west wind. It caused an inflow in the lower layer stronger than normally in June-July. A strong inflow in November-December raised the salinity at the bottom at Halsskov Rev to 3—4 $^0/_{00}$ above normal, and also gave rise to a temperature of 2° above normal at the bottom.

B. The Fish.

Eggs and Larvae. In the western Baltic the numbers of eggs of cod, plaice, flounder, dab and sprat were small, and Kändler assumes that this may be due to a reduction in the stock of spawning fish. Only the number of mackerel eggs had increased. On the other hand an exceptionally large number of cod larvae were found in April and May in the southern Kattegat and the northern part of the Belt Sea.

The plaice and flounder larvae were more than normally abundant in the southern Kattegat and the Belts, as also were the dab larvae in the southern Kattegat, but these were scarce in the Belts.

Cod. In addition, the number of 0-group cod was (after 1. July) very great in these waters, especially in the Belts. In the northern Kattegat the numbers were rather small but at the Norwegian coast they were higher than the average of the previous 20 years and about as high as the mean for 1917—29. The number of the older age-groups was below the average in the Kattegat and very low in the Belts, undoubtedly mainly on account of the very intensive fishery for small cod, 34—40 cm. long, for filleting. At the Norwegian Skagerak coast the stock of grown-up cod was below normal.

Whiting. On the Norwegian Skagerak coast the number of 0-group was below the mean, but in the Belts they were abundant due to a strong inflow during the summer.

Pollack. The 0-group was scarce at the Norwegian coast.

Plaice. In spite of the great number of plaice larvae, the number of the 0-group at the coast was less than normal. More than the normal quantity of I-group was found at the coast, and in the open sea this group was very abundant. It must, therefore, cause an improvement of the yield of the fishery in 1954.

In Nissum Broad in the Limfjord the number of III-group plaice was a little below normal in March, and the numbers of the other age-groups were very low. In June, after the transplantation had taken place, the III-group was also scarce. In August a minor improvement in the density was found but still it was very much below the normal.

Corresponding with the great numbers of 0-group plaice found on the coasts in 1952 the I-group was very numerous in the central Kattegat and in the Belts; in the northern Kattegat the I- and II-group predominated in August. The total failure of these age-groups here in May must be due to migrations, the cause of which is unknown.

The transplantation in the Limfjord was carried out to the same extent as normally. However, the transplantation to the Belt Sea etc. was very restricted because the fishermen

would not fish in the area off Esbjerg, where it was planned to take the fish, as other fisheries were more profitable.

A new tagging method with numbered plastic tags inserted under the skin, partly in connection with tattoing, was used in the Limfjord and the results compared with those of the Petersen disks. It was known that the results of the last named marks were erroneous but Bertelsen reports that the new method gives good results.

Flounder and Turbot. The density of the 0-group was below normal. In the Limfjord the stock of flounder was in some places above the normal, but mostly below the normal. The Isefjord, the Belts and the Sound were the only other areas where flounder were found during the quantitative fishery. The stock was relatively poor and consisted mainly of the II-group.

Dab. In the northern and central Kattegat the stock was very much below normal. In the southern Kattegat and in the Sound it was about normal, in the Belts about half and in the western Baltic about a quarter of the normal. In the Limfjord it was very poor. Most of the dab were of the II-group and a little below the Danish minimum limit, 25 cm.

Fish for Processing. The landings from the Skagerak had increased a little compared with 1952 but were unchanged in the Kattegat. In the other waters the amount is relatively small. It must be remembered that the figures given in Table 7 are total weight of fish used for industrial processing, and that about half of the weight is of fish of sizes otherwise used for human consumption. In the catches from the Skagerak and the northern Kattegat whiting were far less numerous than normally and herring were proportionately more abundant. In the Belt Sea whiting constituted a little more in the catches than in 1952 corresponding to the unusually large amount of 0-group whiting found by the quantitative fishing experiments. However, during the autumn small herring were found in such great quantities in the northern part of the Belt Sea that the whiting and sprat became proportionately few in the catches. A great number of sprat larvae and young sprat of the 1953 year-class were found in these catches.

Others. At the Flødevigen station the hatchings of cod and lobster were successful. The oyster experiments have also been continued with good results. The catches of lobsters per gear on the Norwegian Skagerak coast gave quantities similar to those of the preceding years. Also interesting experiments on the effect of antibiotica are reported by Dannevig. The recent investigations on the Norway prawn fishery have been summarized by Birger Rasmussen especially with respect to the regular control and the necessary research owing to the Danish-Norwegian-Swedish convention.

Aage J. C. Jensen.

ENVIRONMENT

Hydrography.

1. The Norwegian Skagerak Coast.

The sea temperature and density at one metre is recorded every working day at Flødevigen, near Arendal. In 1953 the sea temperature was extremely high in early summer.

Average	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919—29..	3.06	1.60	2.33	4.63	8.80	12.28	15.52	15.63	13.94	10.84	7.14	4.70
1930—39..	3.41	2.73	2.34	4.79	9.39	13.34	16.61	17.37	14.95	11.45	8.09	5.22
1940—49..	2.69	1.67	1.87	4.36	9.46	13.38	16.84	16.99	15.04	11.73	8.11	5.86
1950.....	3.6	2.2	3.2	5.8	10.8	13.0	16.1	17.5	15.1	12.2	7.6	4.6
1951.....	1.3	1.1	1.0	3.6	8.8	13.5	15.0	16.1	15.1	12.6	8.5	7.4
1952.....	5.2	3.1	2.1	4.5	9.8	11.2	14.6	15.9	13.6	9.6	6.0	4.2
1953.....	2.8	2.6	3.2	5.3	9.9	15.6	16.4	16.5	14.7	12.3	9.1	6.9

A. Dannevig.

2. Swedish Waters.

The hydrographic observations from the Swedish lightships "Vinga" (57°34′N., 11°36′ E.) and "Svinbådan" (56°10′N., 12°31′E.) may be taken as representative of the eastern areas of the Kattegat, where the Baltic current usually prevails.

Surface temperatures in 1953 were somewhat higher, during the periods March-July and the last three months of the year than the mean values for 1923—52. Bottom temperature were characterized, particularly at the "Svinbådan", by a negative anomaly in February and March, and by a positive one in August-October.

These two temperature anomalies are associated with low bottom salinities. This happens when the Baltic current is dammed up through the action of westerly winds. Low surface salinities were encountered in June indicating an appreciable outflow of Baltic water due to the fairly calm weather.

N. G. Jerlov.

Table 1. Monthly Means of Salinity and Temperature in 1953 at Surface and Bottom for the Swedish Lightship "Vinga", and "Svinbådan", and Deviations from Mean Values 1923—52.

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity					**Surface**							
"Vinga"	23.21	25.18	23.78	21.79	19.50	17.34	21.73	23.36	24.45	22.43	23.30	24.30
Deviation...	—1.9	0.5	0.5	—0.7	0.1	—3.3	—0.1	1.9	1.5	—2.9	—1.9	—0.3
"Svinbådan"	—	—	—	12.09	11.35	10.60	14.85	14.87	15.41	13.41	16.41	14.58
Deviation...	—	—	—	—1.6	—0.4	—3.0	1.8	1.8	1.6	—2.2	0.9	—1.4
					Bottom							
"Vinga"	33.98	34.15	34.11	33.65	34.47	34.19	33.40	32.77	33.00	33.98	33.64	33.78
Deviation...	0.2	0.3	—0.2	—0.6	0.1	0.1	—0.4	—0.8	—0.9	0.5	—0.4	—0.1
"Svinbådan"	30.91	26.38	25.12	29.30	31.86	32.01	30.49	24.05	24.22	27.63	31.36	30.91
Deviation...	0.5	—3.5	—5.5	—2.3	—0.2	0.7	0.7	—5.6	—5.2	—1.6	1.1	1.2
Temperature					**Surface**							
"Vinga"	1.5	0.4	2.6	5.7	10.4	15.8	17.6	17.1	15.3	12.8	9.6	6.6
Deviation...	—1.2	—1.2	0.7	0.8	0.2	1.3	0.2	—0.9	—0.1	1.4	1.9	1.9
"Svinbådan"	1.3	0.9	2.6	5.9	10.6	15.7	18.3	16.9	14.5	12.1	8.9	5.8
Deviation...	—1.1	—0.6	0.6	1.5	1.3	1.9	1.4	—0.4	—0.5	1.0	1.4	1.5
					Bottom							
"Vinga"	5.9	5.4	4.9	4.8	6.1	7.5	10.0	12.8	14.2	11.9	10.6	9.7
Deviation...	—0.2	0.3	—0.5	—0.2	0.6	0.5	0.7	1.6	2.2	0.1	1.1	1.8
"Svinbådan"	7.1	3.4	3.1	5.2	5.6	6.0	8.2	15.6	14.8	12.8	10.3	9.5
Deviation...	0.5	—1.5	—1.6	0.1	—0.3	—1.0	—1.2	4.6	2.8	1.3	—0.4	1.0

3. Danish Waters.

A strong outflow from the Baltic during April-June brought the surface salinities in the Transition Area considerably below normal, especially in June. An inflow of salt water from the Skagerak, caused bottom salinities well above normal during October-December.

Apart from the winter months the temperature of the surface water was generally above normal. The most pronounced deviations were recorded in November—December at the lightvessels in the Kattegat and amounted to 2.0°—2.9° above normal; but in October and during part of June—July the surface temperatures were also well above normal.

In November—December the bottom temperatures were also high.

HELGE THOMSEN.

Table 2. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessels "Anholt Nord" (A) and "Halsskov Rev" (H) for a Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department)

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity						**Surface**						
A Mean ...	23.5	23.1	20.2	19.2	18 1	18.9	19 4	20.1	20.7	20.7	21.9	22.8
H » ...	16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6	16.2	16.3	15.6
A 1953.....	—2.9	—	2.8	1.1	—1.6	—2.1	—2.1	1.1	1.6	—0.9	—1.1	—0.9
H 1953.....	—1.4	2.1	1.1	—0.4	—2.4	—4.0	—0.6	1.6	1.4	—3.0	2.2	2.1
						Bottom						
A Mean ...	31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8	32.2	32.4	32.1
H » ...	21.9	21.7	24.5	27.6	29.7	30.3	29.4	27.6	24.7	23.3	21.5	22.1
A 1953.....	1.0	—	0.9	—0.1	0.2	0.6	0.1	—0.5	—0.1	0.6	0.6	0.7
H 1953.....	5.1	—1.3	—4.1	—0.3	—0.1	0.8	2.5	0.9	—2.7	0.1	4.7	3.2
Temperature						**Surface**						
A Mean ...	2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5	10.9	7.1	4.1
H » ...	2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5	11.1	7.3	4.0
A 1953.....	—0.4	—	1.2	1.6	1.3	1.6	1.0	0.4	0.5	1.8	2.2	2.1
H 1953.....	—0.5	—0.8	0.1	1.4	1.1	2.0	1.9	0.4	—0.2	1.1	2.0	1.9
						Bottom						
A Mean ...	6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1	12.1	10.2	8.1
H » ...	3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2	11.6	8.4	5.9
A 1953.....	2.1	—	0.8	0.3	0.2	—0.3	2.5	1.2	0.9	1.0	0.7	1.9
H 1953.....	2.2	—1.9	—0.8	0.5	—0.3	—1.0	—1.9	0.0	1.0	1.6	2.3	2.2

Table 3. Monthly Means of Residual Surface Current in cm./sec., at the Lightvessel "Halsskov Rev". The Current from the Baltic is recorded as positive, towards the Baltic as negative.

(From the Danish Meteorological Institute, Nautical Department)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1953.....	—23.3	20.7	—1.2	32.6	12.7	36.3	—7.6	—5.8	15.1	13.4	—13.0	4.4

THE FISH

Eggs and Larvae.

1. Danish Waters.

Gadidae. From the beginning of March until the end of May hauls with the 2 m. ring-trawl were made in order to estimate the quantity of fish larvae. It was found that during March only small numbers of cod larvae occurred, but in April and May these larvae were present in considerable quantities. In fact, 1953 seems to be by far the best year ever recorded in the Danish waters for the survival of cod. Cod larvae were particularly abundant in the S. Kattegat and certain areas in the N. Belts, and a single haul in the former area yielded no less than 3800 cod larvae in 1 hour. The table below gives the number of cod larvae obtained per hour's haul with the 2 m. ring-trawl. The number of hauls is given in italics.

		Central Kattegat	Southern Kattegat	Belts
1953	April	— *0*	643 *4*	393 *9*
	May	606 *1*	— *0*	639 *4*
Average 1923—39	April	—	108	90
	May	—	52	64

J. KNUDSEN.

Flatfish. In March hauls with the 2 m. ring-trawl were carried out in the northern Kattegat. No flatfish larvae were found in these hauls. In 1952 4.3 plaice larvae were caught per hour's fishing in North Kattegat.

The April numbers per hour are given in the opposite column.

In the southern Kattegat the numbers of flatfish larvae greatly exceeded the average value for 1935—39. Very many plaice larvae were found in April in the South Kattegat. In the Belts there were more plaice and flounder larvae than in the years before the war, but fewer dab larvae.

In May some plaice larvae were found in all the Danish waters. Flounder and dab larvae were only found in the northern Kattegat. The numbers caught in April and May per hour's fishing were as follows (in italics number of hauls):—

		April South Kattegat	Belts
Plaice	1953	45 *7*	5.1 *10*
	1952	0.8 *4*	3.0 *1*
	1935—39	0.4	0.6
Flounder	1953	11 *7*	7.8 *10*
	1952	26 *4*	39 *1*
	1935—39	1.2	1.4
Dab	1953	15 *7*	0.9 *10*
	1952	0 *4*	0 *1*
	1935—39	4.2	4.8

		May North Kattegat	Central Kattegat	Belts
Plaice	1953	1.5 *2*	6 *1*	1.2 *5*
	1952	—	—	0.2 *16*
	1935—39	—	0	0.2
Flounder	1953	14 *2*	0 *1*	0 *5*
	1952	—	—	2.1 *16*
	1935—39	—	2.0	1.0
Dab	1953	11 *2*	0 *1*	0 *5*
	1952	—	—	0 *16*
	1935—39	—	2.0	4.4

These results indicate a good brood year of plaice, flounder and dab in the Kattegat.

J. B. KIRKEGAARD.

2. German Waters.

Since January 1953 vertical plankton hauls by means of the Hensen egg-net were carried out from the lightship "Fehmarnbelt" after an interruption of 10 years. Three times a month two hauls are taken. In the 1953 breeding period the average numbers of eggs per m.^{2} and month were as follows:—

		Dec.	Jan.	Feb.	March	April	May	June	July	Aug.
Cod	1953	—	28[1])	2	7	19	4	—	—	—
	1935—43	4	15	81	49	24	3	1	—	—
Plaice	1953	—	0.5[1])	—	0.5	0.5	—	—	—	—
	1935—43	0.5[1])	0.5	2	1	1	—	—	—	—
Flounder and Dab	1953	—	—	—	1	26	10	19	10	1
	1935—43	—	—	8	23	35	35	18	3	—
Sprat	1953	—	—	—	—	—	8	4	13	3
	1935—43	—	—	—	—	—	22	60	60	5
Mackerel	1953	—	—	—	—	—	—	5	2	—
	1935—43	—	—	—	—	—	—	1.5	0.2	—

[1]) Second half of month.

For comparison the average numbers for 1935—43 are added.

The intensity of spawning for all species was, with exception of mackerel, considerably lower than the average for the years 1935—1943. The numbers of flatfish eggs were only one half of those caught formerly, and for cod one third and for sprat one fifth. Obviously the stock of spawning fish has been reduced. Only the eggs of mackerel show an increase. Spawning of cod and plaice had already begun in January, but the cold weather in February caused an interruption so that the numbers of cod eggs show two distinct maxima in January and April.

Further investigations in Kiel Bay with the R/S "Südfall" of the "Institut für Meereskunde" in Kiel confirmed the decrease in egg production for the above-mentioned species:—

Number of fish eggs per m.² in Kiel Bay.

Date:	Jan. 21.—23.	March 5.—7.	March 27.	June 10.—12.	July 9.—10.	July 29.—31.
Number of stations:	12	12	3	5	12	12
Cod	8	16	39	—	—	—
Plaice	0.4	0.8	—	—	—	—
Flounder	—	2	8	—	—	—
Dab	—	—	—	11	13	4
Sprat	—	—	—	0.3	8	2
Mackerel	—	—	—	8	2	—

These numbers are similar to those found in the Fehmarn Belt. Unfortunately in the month of April, which was most important for the spawning of cod and flounder, no trip was made.

Now, as formerly, plaice eggs are very scarce. In vertical and horizontal hauls only 5—6 plaice eggs per 100 cod eggs are caught. The numbers of fry obtained in hauls with the Petersen young-fish-trawl were as follows (numbers of stations see above):—

Number of fish larvae per ½ hour in Kiel Bay.

Date:	March 27.	June 10.—12.	July 9.—10.	July 29.—31.
Cod	10	33	—	—
Flounder	3	—	—	—
Sprat	—	14	24	8
Dab	—	5	354	246
Mackerel	—	—	1	—

The numbers of cod larvae are lower than those in the previous year, indicating only an intermediate brood year.

In 1953 too, enormous quantities of dab fry occurred in Kiel Bay. On two trips in July 12 stations gave an average of 15 and 6 dab larvae per m.² (up to 70 per m.²). These catches indicate a strong influx of saline water by the bottom current from the north which imported many other plankton forms from the Kattegat such as medusae and crustacean larvae.

However, the quantity of eggs of mackerel taken in June and the first half of July was considerable, very few larvae have been observed:—

Number of eggs and larvae of mackerel in Kiel Bay.

Date:		June 10.—12.	July 9.—10.	July 29.—31.
Number of stations:		5	12	12
Number per m.²	eggs	8.2	2.4	—
	larvae	—	0.3	—
Number per ½ hour	eggs	460	393	1
	larvae	—	—	—

Though the numbers of mackerel eggs per m.² did not reach those of the previous year, it is very remarkable that the number of eggs of these fish surpass the indigenous plaice tenfold. There is no information on the success of the plaice spawning in the Western Baltic.

R. Kändler.

Gadidae.

1. The Norwegian Coastal Waters.

The fjords between Kragerø and Mandal.

70—75 routine experimental hauls were made in the littoral region in September and October. The average numbers per haul of 0-group and I-group are given below.

	Cod		Whiting	Pollack
	0-group	I-group[1])	0-group	0-group
1930—39	7.2	1.1	16.3	8.3
1940—49[2])	4.7	1.0	30.1	8.8
1952	8.1	0.2	26.2	4.1
1953	14.7	2.9	12.4	2.6

In 1953 the 0-group cod was relatively numerous, the whiting less so, and the 0-group pollack was scarce.

[1]) A few older specimens may be included.

[2]) The series is incomplete during the war. The few hauls made in 1940—44 are not included.

The Langesundsfjord. 17 hauls.

1953.....	32.1	5.2	23.2	1.4

The Langesund district gave a high number of 0-group cod.

The Oslofjord.

Offshore from Dröbak the number of cod of the 0-group is relatively high in 1953. The number of whiting varies to a considerable degree. The number of young pollack is very low.

In the inner Oslofjord the cod are becoming very scarce, and so are the whiting and pollack.

	Cod 0-Gr.		Cod I-Gr.[1])		Whiting 0-Gr.		Pollack 0-Gr.	
	A	B	A	B	A	B	A	B
1936—39...	50.2	18.8	3.0	2.8	9.8	7.6	4.5	5.0
1940—49[2])..	33.5	2.6	2.5	2.8	38.0	7.4	6.7	0.7
1952.....	16.8	0.0	0.9	0.0	31.2	0.6	5.5	1.7
1953.....	16.9	0.0	2.6	0.0	10.3	0.2	1.3	0.6

A = Offshore from Drøbak.
B = Inner Fjord.
[1]) A few older specimens may be included.
[2]) The series is incomplete during the war. The few hauls made in 1940—44 are not included.

Experimental fishing with traps for older cod at Flødevigen resulted in 80 cod per trap (1952: 85 per trap), mostly 1951 and 1952 year-classes.

Alf Dannevig.

2. Danish Waters.

Cod.

It is seen from Table 4 that in the N. Kattegat only small quantities of cod were obtained. In the S. Kattegat and particularly in the Belts the number of cod was above average. In good agreement with the results obtained by means of the ring-trawl hauls, the 1953 year-class was extremely rich. This will appear in the eel-tog catches in the beginning of July.

Table 4. Number of Cod caught per Hour in the Eel-Tog.

Age-group		0	I	II	III	All year-	Mean
Year-class		1953	1952	1951	1950	classes	1930—39
	No. of Hauls						
N. Kattegat	8	8.4	3.6	0	0	12	74
C. Kattegat	0	—	—	—	—	—	54
S. Kattegat	3	43	1	2	1	47	32
Belts.....	20	389	7	0.7	—	397	38

In this connexion it is of some interest to note that out of 20 hauls in the Belts 7 hauls yielded more than 200 cod per hour, and a single haul yielded no less than 5000 cod of which more than 4000 were 0-group fish.

These findings were confirmed by the results of the hauls with the cod trawl. However, as this material is being worked up in greater detail it will not be reported upon here.

J. Knudsen.

Whiting.

The numbers of whiting caught per hour's fishing during 1953 with the eel-tog are seen from the following figures (number of hauls in italics):—

	1953	1952	Average 1927—39
Kattegat, Sound	16 *13*	7.4 *7*	42
Belt Sea.....	128 *20*	30 *20*	12

It is seen that in both areas more whiting were present during 1953 than in the previous year. In the Kattegat and the Sound the quantity of whiting was considerably below the average for the period 1927—39 while in the Belt Sea the number in 1953 was roughly 10 times larger than the average for that period.

In hauls with the cod trawl much larger quantities of whiting were obtained. The following table gives the number per hour's fishing compared with the results of the two previous years. The number of hauls is given in italics.

	1951	1952	1953	Average 1951—53
N. Kattegat.....	58 *14*	44 *27*	360 *35*	154
C. Kattegat.....	0 *4*	15 *9*	2 *9*	6
S. Kattegat, Sound..	63 *21*	19 *32*	660 *30*	247
Belt Sea.....	51 *55*	95 *49*	226 *32*	124
W. Baltic.....	6 *9*	46 *4*	11 *4*	21

The results obtained from the cod trawl also indicate that the stock of whiting in Danish waters was considerable during 1953, a much greater number being present than during the two previous years. The abundance was due, more especially, to a considerable influx of 0-group whiting during the summer; and during summer and autumn several hauls yielded more than 1000 whiting per hour's fishing. More than 90 % of the catches consisted of 0-group fish.

J. Knudsen.

Plaice, Flounder, and Turbot.

1. Coastal investigations, 0- and I-groups.

The number of 0-group plaice caught per hour with a Johansen young-plaice-trawl was very much below normal in all waters (cp. Table 5). More than the normal quantity of I-group were found in the Belts, the Sound and the southern Kattegat corresponding to the strong 0-group found in these waters in 1952. In the northern and central Kattegat fewer I-group were found than normal as was the case for the 0-group in the northern Kattegat in 1952.

The density of the 0-group flounder was below normal in all waters (cp. Table 5), and practically no 0-group turbot were found, as is most frequently the case.

Table 5. Number of Plaice and Flounder caught per Hour.

In italics: mean for 1927—52 on the Danish coasts, for 1929—38 on the Swedish coasts.

	No. of stat.	Plaice 0-Group		Plaice I-Group		Flounder 0-Group	
Skagerak	6	18	—	3	—	0	—
N. Kattegat	10	42	*77*	38	*26*	0	*0.6*
C. Kattegat	14	4	*29*	4	*4*	1	*1*
S. Kattegat (Danish)	11	8	*24*	2	*0.8*	0	*0.4*
— (Swedish)	7	18	*192*	1	*2*	0.3	*104*
Sound	17	4	*9*	3	*1*	3	*20*
Belts	49	11	*12*	2	*0.9*	0	*8*
W. Baltic	4	0	*6*	1	*0.2*	0	*4*

2. The stock of plaice in the open sea.

It is seen in Table 6 that the quantity of I-group plaice was very high in all waters, except in the southern Kattegat. In the northern Kattegat a peculiar difference was found between May, when very small numbers of I- and II-group were present, and in August-December when large numbers of these age-groups were caught. The densities of both of the 1952 and 1951 year-classes forming these age-groups were above normal and their absence from the trawl and eel-tog catches in May 1953 is astonishing and is difficult to explain.

The numerous plaice of the 1952 year-class had nearly reached the commercial size limit in the autumn in the southern parts of the area, and point to an improvement in the yield in 1954.

Aage J. C. Jensen.

3. The Limfjord stock of plaice.

In 1953 investigations on the stock of fish in the Limfjord were carried out in June and August by means of the eel-tog as usual.

The fishing experiments gave the following numbers of plaice per hour's fishing (the means for the period 1927—52 are given in italics):—

	Nissum Br.	Venø-Kås Br.	Salling-sund	Livø Br.	Thisted-Visby Br.	E. of Salling
June	36 *658*	13 *114*	13 *82*	1.8 *9.6*	4.0 *13*	0 *5.6*
Aug.	210 *918*	1.6 *112*	14 *34*	1.2 *3.8*	0.8 *3.8*	1.0 *1.4*

Table 6. Number of the various Age-Groups of Plaice caught per Hour with Eel-Tog and with Trawl. (Preliminary figures).

Means for 1927—39 in italics. The 0-group means have been calculated from the hauls after 1. July. Trawl means are three times the eel-tog means.

Age-group: / Year-class:		0 1953	I 1952	II 1951	III 1950	IV + 1949—
Eel-tog	No. of stat.[1])					
Northern Kattegat						
15—24 m.	3 *0*	— *0.2*	0 *76*	0 *117*	1 *49*	1 *1*
25—34 m.	1 *0*	— *0*	0 *3*	0 *29*	2 *9*	0 *1*
35—44 m.	4 *0*	— *0*	0 *0.2*	0 *1*	0.5 *1*	0.5 *0.3*
Southern Kattegat						
25—34 m.	3 *1*	0 *0*	0 *1*	1 *0.3*	1 *0.2*	0 *0.03*
Belts						
5—14 m.	5 *5*	64 *3*	245 *7*	40 *5*	1 *2*	0.4 *0.2*
15—35 m.	15 *15*	0.1 *0.4*	10 *2*	2 *2*	0 *0.6*	0 *0.3*

Age-group: / Year-class:		0 1953	I 1952	II 1951	III 1950	IV + 1949—
Trawl	No. of stat.[1])					
Northern Kattegat (Aug.—Dec.)						
5—14 m.	2 *2*	0 *27*	161 *483*	167 *459*	11 *132*	3 *4*
15—24 m.	10 *10*	0 *1*	46 *228*	16 *351*	15 *147*	0 *2*
25—34 m.	6 *6*	0 *1*	20 *9*	13 *87*	11 *27*	0.3 *2*
> 35 m.	8 *8*	0 *0*	2 *1*	2 *4*	1 *4*	0.2 *1*
Central and southern Kattegat						
5—14 m.	7 *5*	0 *9*	204 *60*	7 *45*	1 *3*	0 *0.3*
15—24 m.	10 *9*	0 *0*	1 *2*	4 *1*	1 *1*	0.2 *0.1*
25—34 m.	12 *12*	0	0	6	1	0.5
Belts						
5—14 m.	4 *4*	0 *9*	690 *21*	19 *15*	2 *6*	*1*
14—34 m.	38 *38*	0 *1*	24 *5*	5 *4*	3 *2*	0.2 *1*

[1]) In italics; number of stations after 1. July.

In all parts of the Limfjord, but especially in Nissum Broad, the stock of plaice was far below normal, both in spring and late summer.

The age composition of the stock of plaice in Nissum Broad was as follows:—

Age-group	Year-class	March	June		August	
0.....	1953	—	0	*0*	9.8	*66*
I.....	1952	4.0	4.6	*154*	62	*380*
II.....	1951	13	16	*294*	100	*346*
III.....	1950	144	16	*176*	38	*112*
IV +.....	1949	4.6	0	*36*	0	*22*

The figures are numbers per hour's fishing (in italics the means for 1927—52).

The II-gr. was most numerous, as usual.

Fishing experiments carried out in Nissum Broad showed a decline in the III-group from March to June. This age-group was mainly fished upon during the transplantation.

J. B. Kirkegaard.

Samples were examined for age, length and number of anal fin rays:—

Age-group	Year-class	No. analysed	%	Mean length, cm.	No. of anal fin rays
II.....	1951	124	14	18.4	53.59
III.....	1950	773	85	22.5	53.85
IV.....	1949	15	2	—	—

900 plaice were marked with Petersen disks as in previous years. 60 % were recaptured (1952: 64 %, 1951: 40 %). The recapture percentage by weight was 88 %. In Thisted Broad 85 % of the marked fish were recaptured, and the recapture by weight was 126 %.

In Thisted Broad a new method of tagging the plaice was tried. This method and the results obtained are described below.

J. B. Kirkegaard.

4. Transplantation of plaice.

a. Belt Sea. It was intended to transplant young plaice from Esbjerg to the inner Danish waters. However, as we could not get the fish in the area before late in April, when the temperature was comparatively high, the transplantation was abandoned this year.

Two well-smacks transported 4000 kg. each from the Limfjord to the Belts. 4000 kg. or 37,000 plaice were liberated near Endelave north of Fyn, 4000 kg. near Nexelø north-west of Seeland. They were liberated on 22.—23. March and 100 plaice were marked at each place. At the end of the year 27 % had been recaptured. This is a very good result. In 1952 only 12 % were recaptured.

b. Limfjord. In this area transplantations were carried out as usual from 17. to 28. March; 94 tons or 852,000 fish were caught in Nissum Broad and transported by well-smacks to Thisted and Løgstør Broad. The weather conditions were fine. The temperature in the water was 3—4 °C.

Only 1100 plaice were examined for length and weight. This year the mean length of the plaice was 22.1 cm. and the mean weight 110 g. In 1952 it was 19.9 cm. and 81 g. In 1952 it was the II-group (69 %), which was mainly fished upon, in 1953 it was the III-group. This group belongs to the rich 1950 year-class.

5. Tagging experiments.

The bulk of the catch of plaice in the Limfjord is taken in standing nets. Plaice tagged with Petersen disks were thought to be caught in this gear more easily than untagged, in which case the observed percentages of recaptures would give a false picture of the results of the transplantation. To estimate this probable source of error tagging experiments were carried out during transplantation to Thisted Broad on 19.—20. March 1953. 1050 of the transplanted plaice were tagged: 300 with Petersen disks, 550 were marked with a tattoed ring on the white side and a subcutaneous small plastic tag with a number, and a further 200 carried the subcutaneous tag only. The plaice fishery in Thisted Broad started four weeks after the transplantation and ended in January 1954. During this time the returns were 85 % of the Petersen disks, 44 % of the tattoed fish and 35 % of those with subcutaneous tags only. In this area plaice less than 280 mm. are not allowed to be landed. Only 12 % of the returned plaice with Petersen disks had reached this length, while one third of the returned subcutaneous tagged fish were more than 280 mm.

In Thisted Broad practically no plaice other than those transplanted are present, and from the number of returned tagged plaice

and the weight of those of the marketable size the yield of the fishery can be calculated. This calculation based on the tattoed plaice agreed closely with the fishery statistics, confirming that the fish tagged in this way are caught with the same effectivity as the untagged. The same calculation based on the recaptures of Petersen disks resulted in an overestimation of the catch, especially in the first 3 months after the transplantation. Thus on 1. July, when the fishery had yielded 6.3 tons of plaice, the theoretical catch as calculated from the returns of Petersen disks was 16 tons. This shows that in standing nets the plaice tagged with Petersen disks are caught much more effectively than untagged not only as undersized but also after they have reached the marketable size.

E. Bertelsen.

6. Flounder and turbot in the Limfjord.

It appears that the stock was somewhat above normal in Sallingsund in spring and in Venø-Kås Broad and E. of Salling in autumn. In all other parts of the Limfjord the stock of flounder was below normal.

During investigations in spring and autumn the following numbers of flounder were caught per hour's fishing in various parts of the Limfjord (in italics: means for 1927—52):—

	Nissum Br.	Venø-Kås-Br.	Salling-sund	Livø Br.	Thisted-Visby Br.	E. of Salling
June	0 *0.8*	0 *2.2*	6.0 *2.0*	1.4 *5.2*	2.2 *3.0*	0 *5.0*
Aug.	0 *0.2*	1.2 *0.6*	0 *1.2*	0.6 *4.0*	0.8 *1.2*	2.0 *1.4*

Very few turbot were caught, and then only in Thisted Broad and E. of Salling.

J. B. Kirkegaard.

Dab.

1. Limfjord stock.

Quantitative fishing in different parts of the Limfjord showed a very considerable decrease in the stock of dabs. The numbers per hour's haul with the eel-tog were as follows (in italics: means for 1927—52):—

	Nissum Br.	Venø-Kås Br.	Salling-sund	Livø Br.	Thisted-Visby Br.	E. of Salling
June	6.2 *78*	0 *19*	0 *30*	0 *2.6*	0 *1.6*	0. *0.8*
Aug.	2.8 *188*	0 *40*	4.0 *12*	0 *2.0*	0 *0.4*	0. *0.4*

It is seen that only very few dabs were caught in 1953. The average for the whole Limfjord was 0.6 (1952: 11). This is the lowest average value for any year from 1927 to 1952.

J. B. Kirkegaard.

2. Other Danish waters.

The numbers of dabs caught per hour's fishing with the eel-tog in different parts of the inner Danish waters were as follows:—

	Number of hauls	Number per hour 1953	Number per hour 1952	Average number per hour 1930—39
N. Kattegat..	8	66	—	310
S. Kattegat..	3	237	15	121
Belts.....	17	89	74	176
Sound.....	2	120	—	69
W. Baltic...	4	14	—	93

It is seen that the dab is more numerous than in 1952, especially in S. Kattegat where it was twice as big as the mean for the years before World War II.

Fishing with the cod trawl showed similar results, and as usual the cod trawl yielded larger quantities of dabs. In the following table the number per hour's fishing is given compared with the figures from 1952:—

	Number of hauls	Number per hour 1953	Number per hour 1952
N. Kattegat.....	39	271	221
C. Kattegat.....	7	45	81
S. Kattegat.....	25	348	167
Belts.....	38	312	191
Sound.....	4	69	—
W. Baltic.....	3	51	73

It appears that in the southern Kattegat and the Belts the stock was larger in 1953 than in the previous year. In the following table this is seen clearly; the II-group was dominant. This age-group belongs to the 1951 year-class, the same year-class which was dominant in 1952. The table shows the results of age determinations made by examination of otoliths from the cod trawl material (year-classes given in brackets):—

	Total number of specimens examined	I-group (1952) %	II-group (1951) %	III-group (1950) %
N. Kattegat..	4084	65	29	6
C. Kattegat..	206	11	75	14
S. Kattegat..	994	20	68	11
Belts.....	1078	12	65	23
Sound.....	132	2	42	56
W. Baltic...	38	0	74	26

In the northern Kattegat the 1952 year-class was dominant, but in the Sound it was the 1950 year-class. In all other parts of the Danish waters it was the 1951 year-class which dominated the dab stock this year.

J. B. Kirkegaard.

Fish for Processing.

The Danish fishery for fish-meal factories, fish-pond food and food for fox farms in 1953 showed an increase of 27 % compared with the preceding year, and as shown in Table 7. As usual it was the North Sea, Skagerak and Kattegat that yielded the greatest quantity to this fishery, 95 % of the total. The increase, more than 25 mill. kg., occurred in the North Sea, where the landings were 77 % greater than in 1952.

The main landing ports for the Danish fish for industrial processing were Skagen, Esbjerg, Frederikshavn and Hirtshals.

In September 1953 the total prohibition of landing small herring (less than 45 fish per kg.) was changed to 50 % for the northern part of the southern area (S. Kattegat and Belts), to the north of a line going from Gyllingnæs (north of Horsens fjord) to the south coast of Samsø and from there to Refsnæs (north of Kalundborg fjord, and from Gilbjerghoved to Kullen. The prohibition of landing catches containing more than 50 % small herring was in force in this area as usual, during the season from 1. October to 15. April. Eighteen samples from this fishery were investigated at the laboratory of the Danish Institute for Fisheries and Marine Research partly as a check on the race of the small herring living in these waters. The results from the racial investigations are published on p. 188.

The fishery was carried out with wide- and small-meshed gears and the catches consisted mainly of small herring (7—15 cm.) in addition to larger herring (17—21 cm.), sprat,

Table 7. Catch (in tons) of Fish for Industrial Processing in various Danish Waters during 1950—1953.

	1951	1952	1953
North Sea	34,000	32,859	58,190
Skagerak	47,000	65,948	78,108
Kattegat	23,000	22,528	20,610
Belts	3,200	3,830	4,332
Sound	3	1	1
W. Baltic	110	164	123
E. Baltic	110	136	434
Ringkøbing fjord	16	6	5
Nissum fjord	15	13	3
Limfjord	2,500	3,847	3,344
Total	109,954	129,332	165,150

Table 8. Percentage Abundance (by weight) of Species found in Samples.

Area	Southern Area					Northern Area		
Period:	1/1—15/4 and 1/10—31/12	16/4—30/9	1/1—15/4 and 1/10—31/12	16/4—30/9	Sept.-Oct.	The whole year		
Mesh mm. (knot to knot)	11—14	14—15	16—18	18—22	pound-net	11—14	16—18 prawn-trawl	pound-net
No. of samples	10	12	8	4	4	62	10	4
Whiting	33.1	36.0	36.1	23.4	16.1	25.2	5.8	16.4
Herring	40.6	38.4	38.4	54.4	74.1	45.0	1.7	41.2
Sprat	24.8	19.5	24.3	19.4	8.6	19.8	0.1	0
Other foodfishes	0.6[1]	3.9[1]	0.7[1]	0.5[1]	0.9[1]	2.0[3]	1.9[5]	6.0[7]
Other fishes	1.0[2]	2.0[2]	0.4[2]	2.2[2]	0.4[2]	7.4[4]	90.0[6]	36.0[8]
Invertebrates	+	0.1	0.1	+	0	0.5	0.6	0.6
Total	100.1	99.9	100.0	99.9	100.0	99.9	100.1	100.2

[1]) Cod, dab, mackerel and plaice.
[2]) Norway pout, long rough dab, horse mackerel, greater weever, ling, sandeel and goby.
[3]) Cod, haddock, dab, mackerel, sole and plaice.
[4]) Poor cod, Norway pout, Couch's whiting, long rough dab, horse mackerel, grey gurnard, dragonet, rocklings, whiting pout, silvery pout, *Lycodes*, goby, scaldback, *Lumpenus* and sandeel.
[5]) Haddock, hake, dab and witch.
[6]) Poor cod, Norway pout (39.7 %), Couch's whiting (34.4 %), long rough dab, horse mackerel, grey gurnard, dragonet, rocklings, whiting pout, silvery pout, *Lycodes*, goby, scaldback, *Lumpenus* and sandeel.
[7]) Cod, mackerel, plaice and witch.
[8]) Norway pout, horse mackerel (37.1 %) and grey gurnard.

whiting, long rough dab, horse mackerel, ling, greater weever and sandeel.

During 1953 77 samples of fish for industrial processing from the northern area (Skagerak and northern Kattegat) and 56 samples from the southern area (southern Kattegat and the Belts) were investigated either at the ports by the fishery control or at the laboratory; Table 8 shows the percentage abundance by weight of species found in the samples from the various areas.

It is seen from the table that ca. one fourth of the catches from the northern area consisted of whiting. When the catches from the northern part of the Belts, after 1. September, and from north of Kalundborg fjord are excluded whiting constituted ca. one third of the catches from the southern area. This fish is highly regarded as food in the Danish trout farms being a meagre fish. According to the North Sea Convention landing of whiting smaller than 20 cm. is prohibited from 1. April 1954 in Kattegat and Skagerak and our trout farmers must now find out a method to replace the whiting in the food.

In some cases undersized fish are found in the landings. For example it may be mentioned that in one catch from the northern area 19 % of the weight was cod under the Danish size limit, 34 cm. Such landings are subject to a fine when seen by the fishery control.

Inger Bohus Jensen.

Hatching and Rearing.

The hatching resulted in the liberation of 117.4 million cod larvae and 10.1 million eggs in late stages. The rearing of lobster larvae was successful—more than 34,000 small lobsters were liberated.

In the laboratory, experiments were carried out with eggs and larvae of different species. In some experiments on the hatching of fish eggs antibiotica were added to the sea water. The results were positive. Experiments were also undertaken on the effect of injecting antibiotica on tailrot and other ulcers of adult fish. The results were encouraging.

Feeding experiments on cod and plaice larvae proved that the larvae were able to take food even if not fed till they were two weeks old.

Alf Dannevig.

SHELLFISH

MOLLUSCA

Oyster.

The conditions for the oyster were extremely good in the natural ponds near Arendal. In the artificial pond at Flødevigen we had a heavy spawning, but a poor spatfall.

A. Dannevig.

CRUSTACEA

Lobster.

On the coast between Kragerø and Lista we have for many years collected precise information of the catches of 25 to 30 of the fishermen. The figures below give the number of lobsters above 21 cm. length per gear used:—

Average	Jomfruland-Risør	Arendal-Ulvøysund	Skogsøy-Lista
1928/39.....	10.2	5.8	3.2
1940/49.....	14.6	6.5	4.3
1952.....	8.7	6.2	4.6
1953.....	9.1	6.9	3.5

The number af lobsters per gear is much higher in the eastern than in the western district. The number of gear per fisherman is just the opposite.

The number caught in 1953 does not vary considerably from the earlier years.

Alf Dannevig.

Prawn.

On the Closing of the Cod-End in the Prawn-Trawl and its Effect upon the Catch.

In connexion with the question of protective measures for the deep-sea prawn on a prawn field in the Oslofjord, material has been collected which may throw some light on the best method of closing the cod-end of the prawn-trawl in order to protect the prawn population as much as possible without changing the mesh. The material at hand consists of eleven samples taken from the autumn of 1951 to the autumn of 1952. Once a month a sample was taken which contained prawns caught with laced cod-end, and a second sample taken the same day containing prawns from a cod-end pursed together and closed with a knot in the usual way. The material consists of 4,300 prawns from laced cod-end and 4,900 prawns from pursed cod-end, or a total of 9,200 prawns which have been sorted and measured.

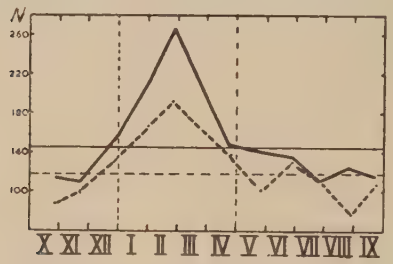


Figure 1. Number of prawns per litre caught in pursed (solid line) and laced (broken line) cod-end.

In the sampling an ordinary 16 fathoms commercial prawn-trawl was employed. The average mesh size was 30.78 mm. internal stretched measure. This is somewhat above the Inter-Scandinavian minimum size of 30 mm.

The towing time for each single haul varies between 2.5 and 4.0 hours. In the trawl with laced cod-end the catches have varied between 8 and 50 kg. per haul, with an average of 9.1 kg. per hour's fishing. In the trawl with pursed cod-end the catches have varied between 4 and 60 kg. per haul, average, 9.0 kg. Thus the catching capacity of trawls with laced and pursed cod-ends is nearly the same.

The samples were measured in litres and the number of prawns was counted in each litre, see Figure 1. The number of prawns per litre varies from one month to the other throughout the year. In the laced cod-end we find a variation between 77 and 129 prawns per litre with an average of 119 for the year. In the pursed cod-end, the number varies between 110 and 268 per litre, averaging 146 for the year. On an average 22.5 % more prawns are taken annually in the pursed cod-end than in the laced one, although the average catch in kg. is almost identical. As seen in Figure 1 the number of prawns per litre in both cod-ends is largest in the winter months from January to the end of April.

It is obvious that the single prawn must be small when the number per litre is high. From

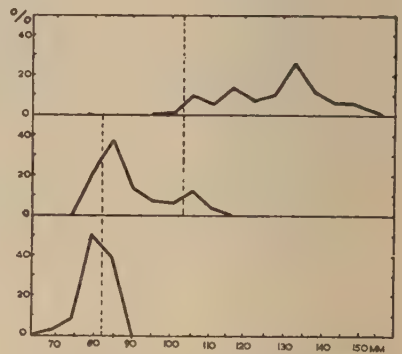


Figure 2. Size distribution of various categories of prawns sorted by sieve onboard fishing vessel.

this simple fact we find that particularly in winter the laced cod-end is capable to save the small youngs of the prawn.

In August 1952 I had the opportunity to investigate how the prawn catches were composed with regard to *market sizes.* On the fishing vessels the prawns are generally sorted with a sieve into three categories, namely the large export prawn, the medium cannery prawn and the small prawns which usually find no market. In Figure 2 is shown how in August the prawns are sorted into these categories. The line between export prawns and cannery prawns lies about 10.25 cm., and between the cannery prawns and small ones at about 8.25 cm. The one group will, however, partly overlap the other. In the following I have assumed that prawns below 8.25 cm. are of no value and thrown away, while prawns be-

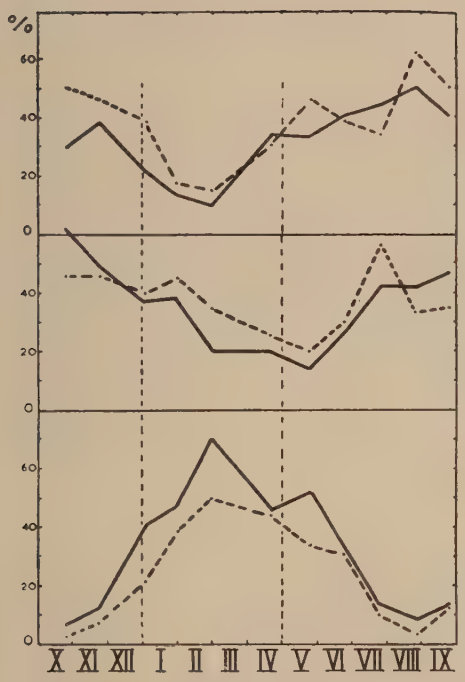


Figure 3. The percentage composition of export prawns (top), cannery prawns (centre) and small prawns (bottom) caught in pursed (solid line) and laced (broken line) cod-end, respectively.

tween 8.25 and 10.25 cm. are cannery prawns, and prawns above that size are export prawns.

In Figure 3 is shown how many prawns, expressed in percentages of the catch, are found within the different categories in the various months of the year. The numbers are given both for laced and pursed cod-end.

In both laced and pursed cod-end the valueless small prawns are caught in greatest quantities from January to the end of May. But the laced cod-end again proves its saving ability as regards small prawns. At the end of February we thus find in the pursed cod-end approximately 70 % valueless small prawns, while the highest percentage in the laced cod-end is about 50 %. Taking all hauls throughout the year we find that the laced cod-end contains on an average 26.5 % small valueless prawns, while the pursed cod-end contains 36.6 %.

The category cannery prawns is mostly found in the summer and autumn. As it will appear from the figure the laced cod-end generally catches more cannery prawns than does the pursed cod-end.

The category export prawns is present in only limited numbers from January to April, while the prawns become more numerous in late summer and autumn. It is apparent that the laced cod-end generally catches more large prawns. For the whole year the laced cod-end gives on an average 36 % export prawns while the pursed cod-end gives only 27 %.

The question of *protective measures* for the prawns has, however, also an economical side which cannot be disregarded. We have hitherto treated the catches on the basis of the numerical occurrence of the different size-categories. But the fishermen do not consider the value of their catches from the standpoint of the number of prawns caught, but according to the weight in kg. It is the weight of prawns that can be sold which they are paid for.

On the basis of the size of the prawns we can by means of length/weight curves figure out how many kg. of the respective commercial categories there will be in the prawn catches. In Figure 4 is illustrated the quantity of prawns (in kg.) present in a catch of 100 kg. in the different months of the year. A

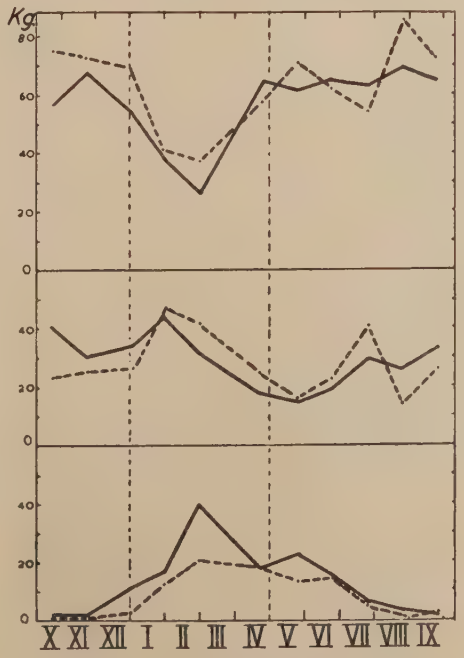


Figure 4. Weight relationship between different commercial sizes of prawns (export prawns = top, cannery prawns = centre, and small prawns = bottom) caught in pursed (solid line) and laced (broken line) cod-end in the different months.

separate curve is given for each size-category and for pursed and laced cod-end respectively.

It is apparent that the weight of the small valueless prawns is greater in the pursed cod-end than in the laced one. Thus at the end of February, the pursed cod-end contains for instance 40 kg. of valueless small prawns, 32 kg. of cannery prawns and 28 kg. of export prawns, together 100 kg. On the same day the laced cod-end catches only 20 kg. of small prawns, or 50 % of those found in the pursed cod-end, while the valuable cannery prawns and export prawns are found in correspondingly larger numbers. The general picture is that the laced cod-end catches a larger weight of valuable prawns, although in late autumn the way of closing the cod-end seems to play a small rôle.

It is apparent that the value of the catch will change in accordance with the weight of cannery prawns and export prawns found in the trawl. From the point of view of making the fishery pay the quantity of export prawns caught will be the most important factor.

But more experimental work by the different countries interested is perhaps needed to prove conclusively the effect of such protective measures as indicated here.

Birger Rasmussen.

Baltic Area.

INTRODUCTION

Contributions to this report have been received from Dr. Aage J. C. Jensen, Mr. Helge Thomsen, and Mr. J. Knudsen, Copenhagen; Dr. G. Granqvist, Helsinki; Professor R. Kändler, Kiel; Dr. F. Koczy, Mr. G. Otterlind, Gothenburg, and Mr. Sten Vallin, Drottningholm.

Environment.

Thomsen's and Koczy's contributions show that the influx of new water of high salinity through the Sound and the Belts must have been weak in 1952 and 1953. The salinity of the bottom layer of the deep basins is still high but the oxygen content is very low. The transition layer in these basins has risen to 60 metres below the surface. The surface temperature was rather high in spring and in June and July.

The Danish observations of the fat content of the plankton in the southern Baltic have been continued. Jensen found that the fat content was somewhat higher in 1953 than in 1952 but the samples from these two years are not quite comparable as those from 1952 were taken in August and those from 1953 in September. The fat content decreased from the Bornholm area westward.

Vallin reports that the parasitic mould on *Eurytemora hirundoides* also occurred in 1953 causing some interference with the herring fishery in the Bothnian Sea. The mould, which belongs to a new species, has been called *Leptolegnia baltica*.

Fish Species.

In his report of the Danish investigations on the occurrence of the different age-groups of the flatfish, Jensen states that the stock of these species is still very weak.

According to Jensen's and Otterlind's investigations the stock of cod in the southern Baltic is strong. Both authors, however, have found that the cod was absent or scarce in the deepest part of the Bornholm Basin which they ascribe to the lack of oxygen in the bottom layer in this basin due, certainly, to an insufficient renewal of the water of this layer. Otterlind's investigations indicate that the growth rate of the cod is smaller in the area south of Blekinge than off the southern coast of Scania. He is, however, of the opinion that further investigations on this problem are needed.

Knudsen's and Kändler's contributions deal with the salmon fishery with floating lines. They both state that the catches of this fishery have decreased. Kändler shows that the largest catches are landed in Germany in the months November-March, i.e., in the same period as in Denmark and Sweden. Both Knudsen and Kändler have found that by far the greatest part of the total catch now consists of small salmon and Knudsen has also shown that the greatest quantity of small salmon is caught in mid-winter. These two contributions confirm some of the results of Alm's investigations on the Baltic salmon fishery (Ann. Biol. Vol. IX, 1952), and are a further reminder of the alarming development of this fishery.

Chr. Hessle.

ENVIRONMENT

Hydrography.

Danish Observations.

Table 1. Monthly Means of Surface Temperature and Salinity at Christiansø, 1953.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature	3.5	1.8	2.5	3.9	6.3	13.3	17.4	17.2	13.9	12.0	9.0	6.7
Salinity ‰	7.3	7.2	7.7	7.7	7.6	7.6	7.4	7.5	7.6	7.6	7.7	7.8

The monthly mean temperatures of the surface water were normal or slightly above normal throughout the year. The highest deviations occurred in June and July and amounted to 2.3° and 2.2° respectively.

The monthly mean salinities were slightly above normal, especially in spring and autumn.

The extremely high saline water, which had entered the Bornholm Deep by the end of 1951 was still present in the middle of September 1953, when a salinity of 20.43‰ was recorded at the bottom (100 m.) near Christiansø. By the end of April the oxygen content at 100 m. had fallen below 2 % saturation, and in September the oxygen content at 70 m. was also below 2 % saturation.

HELGE THOMSEN.

Swedish Observations.

The hydrographic situation as shown by the observations from the lightships (Tables 2 and 3) during 1953 is characterized by high surface temperatures in May and June and also during the late autumn. Exceptionally low temperatures prevailed during January and August. In the bottom layer the high temperature during August at Finngrundet must be mentioned, being 4° above the average taken over ten years. Its cause is found in the early start of the summer. The maximum surface temperature is reached during July, and is followed by high values in the bottom water in the second half of the year.

No exceptional deviation could be recorded in the salinity values. The 20 ‰ front reaches Oskarsgrundet, in the Sound, in April and

Table 2. Surface and Bottom Salinities at Swedish Lightships.

A. Surface

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Sydostbrotten	—	—	—	—	5.15	5.08	4.66	3.76	4.65	4.18	5.04	5.34
Deviation	—	—	—	—	+0.3	+0.4	+0.3	—0.5	—0.1	—0.8	—0.1	0.0
Finngrundet	5.48	5.84	—	5.86	5.81	5.84	5.84	5.24	5.39	5.44	5.54	5.49
Deviation	+0.1	+0.5	—	+0.4	+0.4	+0.4	+0.4	0.0	+0.2	+0.1	+0.2	+0.2
Grundkallen	5.50	—	—	5.88	5.82	5.86	5.77	5.73	5.56	5.49	5.80	5.71
Deviation	+0.1	—	—	+0.4	+0.4	+0.5	+0.6	+0.6	+0.3	+0.2	+0.4	+0.4
Svenska Björn	5.77	6.33	—	6.20	6.11	6.20	6.16	5.55	5.66	5.68	6.34	6.69
Deviation	—0.5	+0.2	—	+0.1	+0.2	+0.5	+0.6	+0.1	0.0	+0.2	+0.2	+0.6
Hävringe	6.60	6.87	6.83	7.12	7.27	6.90	6.50	6.94	6.92	6.53	6.54	7.22
Falsterborev	7.61	8.90	7.86	8.64	7.72	7.57	7.50	8.47	10.75	8.44	7.65	9.47
Deviation	—0.6	+0.8	+0.1	+1.1	+0.3	0.0	—0.4	+0.5	+2.8	0.0	—0.6	+1.2
Oskarsgrundet	8.25	10.82	8.98	19.48	7.90	7.94	7.94	10.29	15.73	12.80	8.05	22.92
Deviation	—2.9	—0.4	—1.2	+10.0	+0.5	—1.9	—2.0	+0.7	+5.0	+0.5	—1.5	+10.9

B. Bottom

	Depth m.											
Sydostbrotten	40	—	—	—	—	5.83	5.91	5.90	5.91	5.93	6.09	5.52	5.56
Finngrundet	30	5.56	5.84	—	5.86	5.82	5.84	5.83	5.77	5.85	5.60	5.52	5.62
Grundkallen	40	5.62	5.92	—	5.88	6.00	5.95	5.86	6.20	5.90	5.94	6.12	6.02
Svenska Björn	40	7.35	7.77	—	—	6.85	7.12	7.33	7.22	7.25	—	6.57	6.75
Hävringe	40	6.78	8.31	7.52	8.27	7.42	7.48	7.21	7.79	7.69	7.76	6.60	8.06
Falsterborev	10	7.63	9.72	8.30	10.08	7.84	7.62	7.57	9.25	10.92	8.45	7.67	9.75
Oskarsgrundet	8	8.24	10.82	9.00	20.17	7.86	11.55	9.94	15.36	18.04	21.91	8.06	23.90

Table 3. Monthly Mean Surface and Bottom Temperatures at Swedish Lightships.

A. Surface

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Sydostbrotten	—	—	—	—	3.6	9.0	15.1	15.5	12.2	8.1	5.7	3.5
Deviation	—	—	—	—	—0.8	+0.6	+1.0	+0.1	+0.3	+0.3	+0.9	+0.3
Finngrundet	0.6	—	—	—	3.7	9.8	14.7	15.4	12.7	9.6	5.9	—
Deviation	—1.0	—	—	—	+0.5	+2.5	+0.9	—0.2	+0.6	+1.6	+0.8	—
Grundkallen	0.7	—	—	1.5	4.2	10.4	15.1	15.3	12.9	—	—	4.7
Deviation	—0.8	—	—	+0.4	+1.0	+2.2	+0.8	—0.6	+0.1	—	—	+1.2
Svenska Björn	1.8	—	—	2.2	5.3	11.0	15.5	15.1	12.7	10.4	7.6	5.2
Deviation	—0.6	—	—	+0.5	+1.1	+2.1	+0.8	—0.7	—0.4	+1.4	+1.0	+0.9
Hävringe	1.7	—	0.6	2.8	6.1	12.5	16.3	14.9	12.8	11.3	7.7	5.0
Falsterborev	2.5	1.1	2.1	4.8	8.7	13.8	17.3	15.3	12.7	11.2	9.0	6.5
Deviation	—0.4	—0.7	+0.1	+1.1	+0.9	+1.4	+1.5	—1.2	+2.0	+0.5	+0.6	+1.4
Oskarsgrundet	1.9	—	2.5	4.9	9.0	14.1	17.9	16.2	13.8	11.5	8.4	5.3
Deviation	—0.9	—	+0.3	+0.6	+0.6	+1.0	+1.8	—0.5	—1.0	+0.1	+0.4	+0.6

B. Bottom

	Depth m.											
Sydostbrotten	40	—	—	—	—	1.3	2.1	2.4	2.7	3.2	3.5	6.6	4.6
Finngrundet	30	0.8	—	—	—	3.2	6.5	6.6	9.6	4.8	5.7	5.6	1.3
Grundkallen	40	1.3	—	—	1.1	2.8	3.8	4.5	4.8	4.9	—	—	5.6
Svenska Björn	40	3.7	—	—	1.7	2.7	3.6	3.7	4.3	5.7	7.7	7.8	5.9
Hävringe	40	3.8	—	2.1	2.4	4.1	5.6	4.1	4.5	7.5	6.9	5.3	4.0
Falsterborev	10	2.5	1.1	2.2	4.8	8.2	12.7	16.0	14.5	12.8	11.4	9.2	6.5
Oskarsgrundet	8	2.7	—	2.4	4.9	8.6	13.9	16.9	16.0	14.0	11.9	9.1	6.1

Table 4. Hydrographical Measurements in the Deep Basins of the Central and Southern Baltic.

West of Gotland
57°46′ N., 17°31′ E.
18. March

m.	°C	‰ S	O_2
0	1.00	7.15	—
5	0.99	7.16	—
10	1.01	7.16	9.63
25	0.98	7.16	—
50	1.97	7.57	8.54
60	4.13	8.60	5.47
70	4.52	9.63	2.74
80	4.68	10.25	1.44
93	4.80	10.64	—
117	4.76	10.69	1.11
135	4.82	10.69	1.03

57°29′ N., 17°44.5′ E.
18. July

0	15.98	7.23	—
10	15.68	7.20	6.96
20	6.93	7.30	8.25
30	4.66	7.41	8.29
40	3.83	7.57	8.06
50	2.98	7.90	8.10
70	4.42	8.03	2.17
80	4.70	10.39	—
100	4.84	10.70	0.85

Bornholm Deep
55°31.8′ N., 15°09.5′ E.
17. March

0	2.14	7.49	—
5	2.12	7.50	—
10	2.52	7.49	9.70
15	2.03	7.50	9.41
20	2.14	7.49	—
30	2.12	7.50	9.26
50	2.20	7.57	9.16
60	1.79	10.21	—
70	3.19	—	6.99
80	7.51	18.40	1.15

Gotland Deep
57°20.5′ N., 19°54′ E.
18. March

m.	°C.	‰ S	O_2
0	1.58	7.76	—
5	1.52	7.74	—
10	1.44	7.74	9.35
20	1.45	7.74	—
30	1.60	7.73	9.33
50	1.53	7.78	—
70	1.79	—	9.02
80	5.10	10.19	3.12
90	5.65	11.14	2.56
100	5.62	11.63	2.42
125	5.75	12.40	—
150	5.91	12.99	2.14
175	6.12	13.38	—
200	6.33	13.69	1.43
215	6.35	13.78	—

57°21′ N., 19°58′ E.
17. July

0	16.57	7.23	—
10	16.18	7.25	6.86
20	8.32	7.56	—
30	5.32	7.68	—
40	3.30	7.76	8.27
50	2.70	7.79	—
70	4.41	10.05	2.43
80	4.81	10.61	—
100	5.21	11.17	—
125	5.87	12.45	2.00
148	5.87	12.86	1.76
173	6.13	13.31	—
198	6.31	13.57	—
218	6.36	13.71	0.60

Landsort Deep
58°35′ N., 18°13.5′ E.
18. March

m.	°C.	‰ S	O_2
0	1.25	7.47	—
5	1.26	7.45	9.50
15	1.26	7.45	—
25	1.52	—	1.22
50	2.37	7.96	—
65	4.10	9.25	4.20
75	4.59	10.08	2.44
85	4.84	10.55	1.51
100	4.84	10.74	1.43
125	4.88	11.08	—
150	5.06	11.19	—
175	5.02	11.22	—
200	5.12	11.25	—
250	5.04	11.33	1.42
300	5.15	11.38	—
325	5.29	11.41	1.27
450	5.12	11.42	1.21

58°35′ N., 18°14.5′ E.
18. July

0	16.58	6.65	—
10	16.38	6.67	6.85
20	11.49	7.18	—
30	7.20	7.11	—
40	4.65	7.41	—
50	3.17	7.90	—
70	4.41	10.01	1.78
80	4.69	10.43	—
100	4.93	10.91	1.14
125	4.58	10.23	—
150	5.14	11.46	1.39
200	5.31	11.58	—
250	5.35	11.60	1.49
300	5.32	11.60	—
400	5.38	11.65	—
450	5.40	11.67	1.50

December. At Falsterbo high salinity values have been recorded in August and December indicating that inflow of high salinity waters may have been possible during the later part of the year. No increase in the salinity during June could be detected this year.

Investigations of the hydrographic situation in the deep basins of the Baltic were carried out in March and August. The results are shown in Table 4. No significant changes could be detected. The transition layer had risen by about 10 m. compared with the situation in 1952 and was located at about 60 m. The oxygen content indicates that waters in the deep basins are old and that no renewal had taken place.

F. Koczy.

Finnish Observations.

The observations made at the Finnish hydrographical stations in 1953 show very distinctly that the water temperature was, on average, high; the deviations from the mean values were almost always positive. Table 5 gives the average yearly values and the deviations from those for the surface and bottom temperatures at all the Finnish stations where observations have been adequately complete.

Table 5. Average Surface and Bottom Temperatures in 1953 and Deviations from the Mean Values.

	Surface		Bottom		Depth
	t°	△	t°	△	m.
Tankar	6.4°	+1.5°	5.0°	+1.1°	10
Valsörarna/Valassaaret	6.2°	+1.4°	5.8°	+1.6°	10
Jungfruskär	7.3°	+0.9°	5.1°	+0.6°	40
Lohm	7.4°	+0.6°	5.0°	+0.9°	50
Bengtskär	7.4°	+0.9°	4.9°	+1.3°	40
Tvärminne	7.8°	+1.4°	5.0°	+1.1°	30
Harmaja/Gråhara	6.8°	+0.9°	3.9°	—0.5°	30
Helsinki/Helsingfors	8.9°	+2.4°	—	—	—
Tammio/Stamö	7.5°	+1.2°	4.8°	+0.9°	20

The deviations seem to be somewhat higher at the surface than at the bottom. The deviation of 2.4° at the surface in Helsinki is considerably higher than all the remaining values possibly depending on the fact that the observations are made on-shore and not farther to sea as at the other stations.

The salinity observations within the Finnish sea area distinctly show the considerable in-

Table 6. Deviations from Mean Values of Surface and Bottom Salinities (‰) observed at the Finnish Stations in 1952.

	m.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Ulkokalla	0	0.32	0.23	—	—	—	0.23	0.22	0.18	0.21	0.17	0.17	0.19
	10	0.33	—	—	—	—	0.19	0.18	0.08	0.18	0.20	0.20	0.23
Tankar	0	0.30	0.17	0.10	0.15	0.08	0.29	0.31	0.27	0.20	0.22	0.22	0.13
	10	0.27	0.15	0.12	0.19	0.21	0.28	0.21	0.19	0.26	0.25	0.23	0.09
Valsörarna/Valassaaret	0	0.46	0.35	0.78	0.23	0.07	0.38	1.10	0.64	0.30	0.30	—	—
	10	0.51	0.65	0.70	0.43	—0.06	0.38	0.97	0.33	0.09	0.34	—	—
Säppi/Säbbskär	0	—	—	—	—	0.79	0.48	0.59	0.50	—0.09	0.21	0.36	—
	24	—	—	—	—	0.31	0.16	0.35	0.33	0.22	0.05	0.41	—
Märket	0	—	0.27	—	—	0.28	0.24	0.32	0.78	0.65	0.22	—	—
	100	—	0.30	—	—	0.43	0.32	0.33	0.47	0.43	0.48	—	—
Jungfruskär	0	0.54	0.59	0.67	0.88	1.16	0.36	0.21	0.15	0.36	0.46	0.51	0.07
	40	0.51	0.61	0.57	0.53	0.54	0.50	0.45	0.38	0.28	0.38	0.50	0.04
Lohm	0	0.47	0.51	0.57	0.58	0.87	0.50	0.62	0.53	0.59	0.56	0.19	—0.01
	50	0.47	0.49	0.48	0.41	0.35	0.38	0.43	0.23	0.29	0.39	0.20	0.29
Utö	0	0.57	0.57	0.59	—	0.48	0.49	0.53	0.46	0.52	0.47	—0.11	—
	90	0.52	0.40	0.24	—	0.95	1.86	2.05	2.03	2.04	1.92	1.36	—
Bengtskär	0	0.70	0.72	0.67	0.47	0.55	0.45	0.65	0.70	0.63	0.50	—0.50	—0.29
	40	0.58	0.68	0.56	0.33	0.03	0.31	0.47	0.10	0.54	0.31	—0.21	0.54
Russarö	0	0.71	0.70	0.65	0.24	0.41	0.55	0.85	0.83	0.72	0.47	—0.31	—
	30	0.64	0.66	0.63	0.14	0.30	0.67	0.39	0.06	0.61	0.51	—0.24	—
Tvärminne	0	2.91	3.47	3.04	—0.64	0.56	0.79	0.78	0.80	0.61	0.47	—0.07	0.44
	30	0.83	0.72	0.52	0.44	0.51	0.82	0.56	0.09	0.33	0.46	—0.32	0.49
Harmaja/Gråhara	0	1.32	0.83	0.74	1.81	—0.12	0.47	0.73	0.79	0.76	0.45	—0.41	0.09
	30	1.26	0.63	0.28	0.79	0.54	0.45	0.36	0.39	0.56	0.19	—0.59	0.71
Helsinki/Helsingfors	0	1.70	1.20	2.64	2.00	1.08	1.26	0.80	1.06	1.09	0.43	—0.68	—0.01
	—	—	—	—	—	—	—	—	—	—	—	—	—
Söderskär	0	—	0.46	0.52	0.97	0.88	0.51	0.89	1.11	1.00	0.28	—0.42	—0.23
	50	—	—0.21	0.05	0.03	0.32	0.97	0.27	0.11	0.13	0.39	0.24	1.51
Tammio/Stamö	0	0.86	0.49	0.62	1.51	1.34	1.14	0.13	0.91	0.86	0.50	0.05	0.35
	20	0.53	0.10	0.36	0.36	0.67	0.62	0.50	—0.01	0.25	0.20	0.25	0.67

Table 7. Deviations between the years 1953 and 1952 of Surface and Bottom Salinities (‰).

	m.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Ulkokalla	0	—	—	—	—	—	—0.23	—0.13	—	—	—	—	—
	10	—	—	—	—	—	—0.15	—0.12	—	—	—	—	—
Tankar	0	—0.12	—0.08	+0.04	—0.28	+0.36	—0.06	—0.11	—0.10	—	—	—	—
	10	—0.10	+0.02	—0.01	—0.04	0.00	—0.09	+0.02	+0.07	—	—	—	—
Valsörarna/Valas-	0	—0.33	—0.06	—0.48	—0.45	—0.16	—	—	—	—	—	—	—
saaret	10	—0.02	+0.05	—0.41	—0.65	—0.40	—	—	—	—	—	—	—
Säppi/Säbbskär	0	—	—	—	—	—0.41	—0.13	—0.35	—0.04	0.00	—0.04	—	—
	24	—	—	—	—	—0.02	—0.02	—0.13	—0.08	+0.03	+0.19	—	—
Märket	0	—	—	—	—	+0.06	+0.08	—0.08	—0.53	—0.20	+0.03	—	—
	100	—	—	—	—	+0.14	+0.26	+0.15	—0.36	—0.55	+0.03	—	—
Jungfruskär	0	—0.57	—0.34	—0.04	+0.10	+0.19	—0.07	+0.11	+0.42	+0.35	+0.32	+0.31	+0.27
	40	—0.58	—0.27	—0.04	+0.15	+0.15	+0.13	+0.09	+0.25	+0.41	+0.37	+0.30	+0.40
Lohm	0	—0.03	+0.14	+0.05	+0.16	+0.24	+0.04	+0.05	+0.24	+0.37	+0.32	+0.50	+0.64
	50	+0.02	+0.02	+0.15	+0.18	+0.36	+0.29	+0.34	+0.35	+0.40	+0.31	+0.45	+0.29
Utö	0	—0.21	—	—	—	+0.31	+0.19	+0.26	+0.32	+0.25	+0.25	+0.61	—
	90	+0.27	—	—	—	—0.27	—1.41	—1.73	—1.48	—1.60	—1.52	—1.00	—
Bengtskär	0	—0.15	—0.01	+0.19	+0.73	+0.81	+0.61	—0.15	+0.27	+0.26	+0.20	+1.09	+0.94
	40	+0.01	+0.09	+0.23	+0.58	+0.69	+0.14	+0.01	+0.45	—0.19	+0.06	+0.66	0.00
Russarö	0	0.00	+0.12	+0.11	+0.96	+0.84	+0.54	—0.08	+0.32	+0.26	+0.18	—	—
	30	+0.07	+0.16	+0.15	+0.97	+0.85	+0.15	+0.12	+0.62	—0.03	+0.08	—	—
Tvärminne	0	—1.02	+0.01	—1.30	+3.67	+0.34	+0.19	—0.05	+0.34	+0.40	+0.01	+0.82	+1.06
	30	—0.01	+0.38	+0.37	+0.67	+0.65	—0.12	+0.07	+0.55	+0.09	+0.04	+0.94	+0.36
Harmaja/Gråhara	0	—0.58	+0.60	+0.68	+0.57	+0.86	—	—	—	—	—	—	—
	30	—0.41	+0.67	+0.69	+0.53	+0.22	—	—	—	—	—	—	—
Helsinki/Helsingfors	0	—1.99	+0.83	—2.01	+0.62	+0.41	—0.07	—0.32	—0.04	—0.11	+0.44	+1.67	+1.37
	—	—	—	—	—	—	—	—	—	—	—	—	—
Söderskär	0	—	+0.51	+0.17	+1.09	+0.20	—0.16	—0.33	—0.01	—0.12	+0.19	+0.88	—
	50	—	+0.78	+0.21	+0.05	—0.52	—0.71	+0.40	—0.26	—0.20	+0.07	+0.26	—
Tammio/Stamö	0	+0.03	+0.43	0.00	—1.26	—1.26	—0.28	—0.36	—0.16	—0.43	—0.08	+0.47	+0.35
	20	+0.13	+1.03	+0.66	+0.67	+0.14	—0.32	+0.67	+0.34	—0.27	+0.28	+0.10	0.00

crease in salinity noted from the beginning of the forties. As the analyses of the salinity observations for 1953 are not yet completed we give in Table 6 the deviations in salinity between the actual values for 1952 and the mean values. This table which refers to the first of each month shows that, with the exception of the observations for November in the western part of the Gulf of Finland and a lesser number of scattered cases mainly connected with ice and snow melting, the deviations are positive sometimes reaching values of 1 to 2 ‰. The even greater deviations observed, for instance, at Tvärminne in the beginning of the year are probably due to the unstable salinity characteristic of the surface at this station, which is situated in the mouth of a narrow bay.

Finally, Table 7 gives the deviations in salinity between 1953 and 1952. Though this table is by no means complete the large number of positive deviations, especially in the south-west and south parts of the Finnish sea area, indicates a continued increase in salinity. On the other hand the salinities at the stations in the Gulf of Bothnia and at the bottom at Utö and a number of salinity data in the easternmost parts of the Gulf of Finland were in 1953 lower than in 1952.

Gunnar Granqvist.

Plankton.

Danish Observations.

Vertical-haul plankton collections were made in September from the S/S "Biologen". Only one or two samples have been taken at Christiansø during the year.

The fat content was as follows (the number of samples in brackets): —

	Average %	Range %
At Møen.....	15 (2)	14—15
South of Scania ...	23 (3)	21—25
At Bornholm.....	32 (9)	17—38

It is seen that the fat content at Bornholm was higher than in August 1952. This may be due to the somewhat later time of the sampling, because a secondary autumn maximum may exist. However, there is not sufficient evidence to show if such a secondary maximum is a regular phenomenon. The fat content decreased from Bornholm westwards.

Aage J. C. Jensen.

Swedish Observations.

The mortality of *Eurytemora* in the Bothnian Sea in the summer of 1953 caused by the parasitic *Leptolegnia* spec. has been described and some samples have been investigated. The mortality was first observed on 14. July off Sundsvall and during the period 15. to 21. July the herring nets in the area Alnön-Lörudden-Skatan were clogged with dead *Eurytemora*. To the south of this area the plankton mortality interfered less with the fishing. In August the epidemic was noticed to some extent, but fishing could go on without hindrance. It is worth noting that the last two weeks of June and the first weeks of July were warm, with rather high surface temperatures. From the middle of July a colder period set in with NW. winds and decreasing surface temperatures in the waters off the coast. This confirms the occurrence in 1950—52 of the most intense mortality being connected with warm surface water in the coastal areas.

The parasitic mould is now described, being a new species—*Leptolegnia baltica*, Höhnk and Vallin.[1])

Sten Vallin.

[1]) Höhnk, W. & Vallin, Sten, 1953. "Epidemisches Absterben von *Eurytemora* im Bottnischen Meerbusen verursacht durch *Leptolegnia baltica*, nov. spec." Veröff. Inst. Meeresforsch. Bremerhaven, **2**, 215—23.

THE FISH

Cod.

Danish Observations.

Quite large numbers of the 0-group were found off Seeland and Møen, and in addition the number of older cod was somewhat larger than in 1952. South of Scania the 0-group was scarce and round Bornholm none of these were found. The I- and older groups were about as abundant to the south of Scania as in 1952, but round Bornholm their density was only a tenth of that of 1952 (see Table 8). The scarcity of cod in this area may be due, partly at least, to the low oxygen saturation at depths below ca. 80 m. Very often the Bornholm fishermen went to the more easterly banks to fish cod.

The number of "Bulldog noses" were found in proportionately smaller numbers than in the previous years.

Aage J. C. Jensen.

Table 8. Length Distribution of Cod in the Baltic in September-October 1953 compared with 1952.

(1-hour trawl catches[1]).

	Off Seeland and Møen		S. of Scania		Round Bornholm			
Year	1952	1953	1952	1953	1952	1953	1952	1953
Depth, m.	17/25	16/23	30/44	34/43	46	40	70/98	72/77[2])
cm.-group								
5...	—	—	0.5	—	4	—	—	—
6—10...	6	70	62	31	22	—	1	1
11—15...	0.5	62	4	3	—	—	19	0.5
16—20...	2	3	—	6	—	—	63	2
21—25...	6	3	—	10	—	—	62	3
26—30...	4	8	2	4	—	3	56	7
31—35...	2	10	8	8	—	2	30	5
36—40...	2	10	12	12	2	6	14	3
41—45...	2	6	10	13	14	6	6	1
46—50...	—	3	9	7	2	1	4	2
51—55...	2	1	10	8	—	—	4	1
56—60...	—	0.3	4	1	—	—	1	0
61—65...	—	—	3	1	—	—	0.6	0.2
66—70...	—	—	2	0.4	4	—	—	—
71—75...	—	—	1	—	2	—	0.2	—
76...	—	—	0.5	—	—	—	—	—
No. of stat.	4	7	4	5	1	2	10	8
Mean number per hour	27	178	128	104	50	18	260	25

[1]) Catch in eel-tog included reckoning its catch capacity = 1/3 of the trawl.

[2]) No cod below this depth.

Swedish Observations.

In 1953 the cod fishery in the southern Baltic was characterized by the almost complete disappearance of cod from the deep basin off Christiansø (NE. of Bornholm). No doubt the explanation of this phenomenon is the lack of oxygen in the bottom layer due to a very weak influx of new salt water to the Bornholm Deep. Good catches were made, however, in somewhat shallower water especially off Svaneke and Nexø in Bornholm. In July and August the largest catches were made SSE. of Nexø in depths of 70—75 m. According to Swedish fishermen ca. 75 % of these catches at the end of July consisted of individuals just about to spawn.

During investigations by the research vessel "Eystrasalt" in July-August trawling was carried out principally in three areas in the southern Baltic:—A) south of the southern coast of Scania at a distance of 4—20 naut. miles and in depths of 27—48 m. (6 hauls); B) west and north of Bornholm (mainly ca. 11 naut. miles WNW. of Rønne and ca. 13 naut. miles SE.-E. of Simrishamn) in depths of 44—77 m. (7 hauls). (North of Christiansø in a depth of 87 m. a haul gave no catch at all, as was expected); C) south of the southeastern coast of Sweden (Blekinge) at a distance of 3—7 naut. miles and in depths of 38—50 m. (4 hauls).

In area A, age-group II was predominant (mean length = 36 cm.). Of the specimens examined (627) 98 % were in maturity stages I and II. 865 were measured.

In area B, age-group I was predominant (mean length = 19 cm.). The maturity stages were locally more variable. SE.-E. of Simrishamn in depths of 65—67 m. 40 % of the fish were in maturity stages V and VI. At a fishing ground about 11 naut. miles SW. of Kåsehuvud (SE. Scania) in a depth of 46 m. out of 100 specimens examined 99 were in maturity stages I and II. 1324 were measured.

In area C, age-groups III, IV, and locally V were dominant (mean length: 30, 31, and 38 cm. respectively). Out of 153 specimens examined 97 % were of maturity stages I and II. The total number measured was 1275.

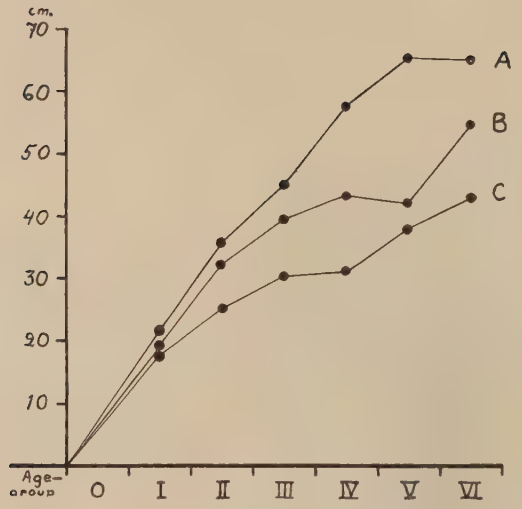


Figure 1. Diagrams demonstrating the growth rate of the cod in three different areas of the southern Baltic. For details see the text.

Age determinations were made by means of the otoliths. The number of specimens examined was 575. Out of these 420 otoliths were readable. The growth rates in the different areas are shown in Figure 1. In the coastal waters of south-eastern Sweden, especially off Blekinge (area C) the growth rate of the cod appears to be significantly smaller than that off the southern coast of Scania (area A). In the waters between south-eastern Scania and the northern coast of Bornholm both types of growth rate were noted in the samples. Further investigations will be made on this problem. Secondary rings in the otoliths may be a possible source of error.

Gunnar Otterlind.

Flatfish.

0-group.

We have no information on the density in 1953 of the 0-group of plaice and flounder at Seeland and Møen. At Bornholm the usual numbers of 0-group plaice and turbot were found, but there were more I-group plaice than usual which corresponded with the occurrence of many plaice in 1952. The density of 0-group flounder was less than normal.

Older age-groups.

The density and age distribution of the older age-groups caught by quantitative fishing from the S/S "Biologen" in September-October 1953 east of Seeland and at Møen (7 stations) were as shown in the figures below: —

Mean number of flatfish trawled per hour.

Age-group	Plaice	Flounder	Dab
I	1	—	7
II	2	0.3	37
III	6	0.3	12

The age distribution of plaice and dab corresponds with the findings in 1952 of proportionately great numbers of II-group plaice (year-class 1950) and of I-group dab (year-class 1951). As in 1952 the number of flounders was very small. South of Scania, flatfish were only found at one of the two trawl stations, and none at three eel-tog stations. This gives an average of 1 III-group and 0.4 IV-group plaice per hour's trawling. At Bornholm no flatfish were caught during the fishing experiments. The stock of flatfish is very low south of Scania and at Bornholm.

Aage J. C. Jensen.

Salmon.

Danish Observations.

The total output in 1953 of the Danish salmon fishery in the Baltic amounted to 850,000 kg. against 1,350,000 kg. in 1952. This fishery has now been carried out since 1947 on a rather large scale, and during this period there has been an almost continuous decline in the average size of the salmon (Knudsen, unpublished). Thus it has been found that in the season 1948/49 the average length was 96.3 cm., decreasing to 73.9 cm. in the 1952/53 season. During the seasons 1948/49 to 1951/52 salmon of 90—99 cm. length dominated the catches and there was a decreasing proportion of salmon larger than 99 cm. In the season 1952/53 a radical change set in, salmon of 60—69 cm. now form the majority of the catches.

During 1953 scales and length measurements were collected, partly from commercial catches and partly from the catches of the experimental cutter "Jens Væver". The size composition of the material which was collected during the autumn of 1953 is seen in Figure 2. It is seen that the size distribution does not differ very much in the 3 samples. In all, the group 60—69 cm. length is dominant, forming 32 to 44 % of the catch, the bigger size groups being of ever decreasing importance. The 90—99 cm. group, which in previous years formed an

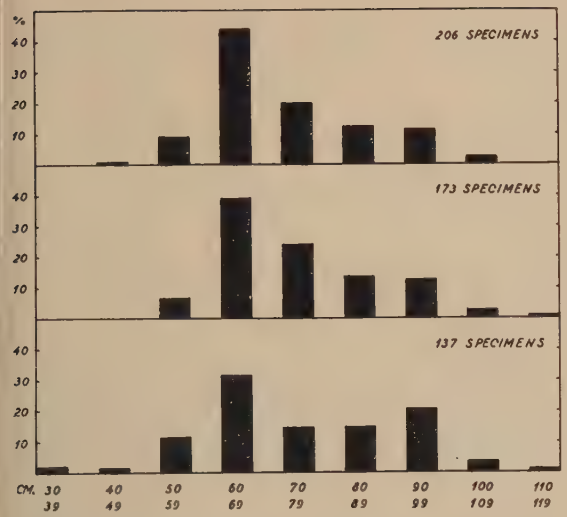


Figure 2. The two uppermost histograms show the length compositions of two commercial landings of salmon. The lowest histogram shows the length composition of salmon caught by the cutter "Jens Væver". All samples originate from the autumn of 1953.

essential part of the catches, is of minor importance comprising 11 to 21 %.

It has been possible to demonstrate a striking seasonal variation in the proportion of small salmon throughout the year. Statistics, of the weight of salmon landed, obtained from the Ministry of Fisheries (each salmon was weighed separately) shows this clearly. The histogram (Figure 3) shows the percentage of salmon below 3 kg. (cleaned) in the commercial catches. The total number of salmon included is given below the histogram. It is seen that in January the small salmon formed nearly 50 % of the catches, while the percentage decreased gradually towards the end of the season, being only about 15 in June. At the start of the next season in September the proportion of small salmon is again somewhat higher followed by a rapid increase to no less than 56 % in December.

J. KNUDSEN.

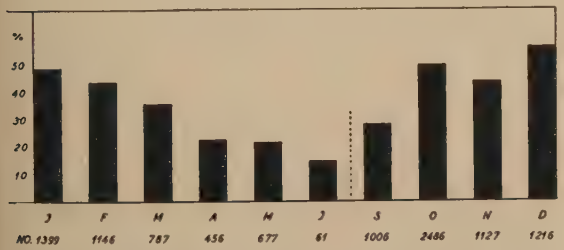


Figure 3. Percentage of salmon <3 kg. by months. The material originates from commercial samples and the total number of weighings each month is given below the columns.

German Observations.

In December 1948 the first attempt was made by the Schleswig-Holstein fishermen to catch salmon in the south-eastern parts of the Baltic by means of drift lines. The yield of this fishery increased till 1950 and has since declined: —

1948.....	6 tons	1951.....	136 tons
1949.....	59 »	1952.....	144 »
1950.....	183 »	1953.....	75 »

Generally the fishery begins in the middle of October and lasts until April or May; the largest catches are landed in November-March; the monthly catch of salmon, in percentage of the annual catch and calculated as mean of 1950—53 is set out in the figures below: —

I	II	III	IV	V	VI-IX	X	XI	XII
18.9	18.5	14.7	8.6	2.6	—	1.6	10.0	25.1

If we consider the mean landing per trip, the decrease of the catch since 1950/51 is evident: —

1949/50.....	788 kg.	1951/52.....	539 kg
1950/51.....	781 »	1952/53.....	330 »

Although the catches in December 1953 were good, the decline continues in the season 1953/54 in consequence of the severe winter.

The percentage size composition of the salmon landings in Kiel in November and December 1953 was as follows: —

Percentage of different size groups of salmon, November, December 1953.

	Kg.	<2.9	3—5.9	6—7.9	>8
November	Number	54.5	20.5	20.5	4.5
	Weight	29.1	26.8	34.0	10.1
December	Number	54.9	24.6	16.3	4.2
	Weight	29.3	31.6	28.8	10.3

More than half of the landings were represented by small salmon less than 6 kg., the amount of big fish heavier than 8 kg. was very low only 10 % of the total catch.

R. KÄNDLER.

Herring.

INTRODUCTION

Contributions to this, the fifth report of the Herring Sub-Committee have been received from the following countries:—

Belgium
M. C. Gilis

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Mr. K. Popp Madsen — Dr. Å. Vedel Tåning

England
Mr. G. C. Bolster — Mr. R. J. Wood
Mr. A. C. Burd — Dr. W. C. Hodgson

France
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Germany
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Holland
M. J. de Veen — M. L. K. Boerema

Iceland
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Norway
Mr. F. Devold — Mr. O. Aasen

Scotland
Mr. B. B. Parrish — Mr. J. D. Buchan
Mr. I. G. Baxter — Mr. A. Saville
Mr. G. McPherson

It will be remembered that, at the special meeting of experts held in Edinburgh, 1949, a recommendation asking all countries to keep a close watch for signs of stock changes, was adopted, and it is hoped that some reports will soon be forthcoming. Stock changes are certainly taking place on the English east coast where a new stock of fish with a very low Vert. S. has appeared since the war, and in the regular commercial fishing the "catch per landing" has steadily declined from 61.0 crans in 1945 to 39.8 crans in 1953. Further, the average mortality rate has increased from 39.1 % during 1946—50 to 47.7 % during 1950—53.

The enormously successful fisheries for immature herrings in the southern half of the North Sea are mentioned below and one is bound to view the removal of some 80,000 tons of small herrings from the stocks with at least some concern for the future of the fishery.

One must also consider the greatly increased activity by the trawling fleets during the late autumn and winter spawning period, when vast quantities of ripe and spawning fish are caught, and the question of the ability of our stocks to withstand this strain is bound to arise sooner or later.

W. C. Hodgson.

REPORTS

A. Atlantic Waters.

COMMERCIAL FISH

Iceland.

The Icelandic North Coast Herring in 1953.

As during the eight previous seasons, the yield of the herring fishery was a failure in 1953. The total catch amounted to 40,555 tons or 450,578 hectolitres. This is considerably more than in 1952 (98,572 hl.), which was the poorest in a long series of bad seasons. About 178,900 hl. were reduced to oil and meal, the remainder being salted or frozen for bait. Almost all the catch was taken in July, as the August fishery failed almost entirely.

During the summer and autumn 3931 herrings (40 samples) were examined for length, sex, stages of maturity, intestinal fat, number of vertebrae, age, growth-type, total weight, and weight of the gonads. Otoliths were also examined. Three of the samples (Nos. 38—40) comprising 297 fish were caught in September-October, whereas the main material (Nos. 1—37) originated from the usual season in July and August.

When analysing the material according to type, it appeared that the samples were rather heterogeneous, which made it necessary to divide them into three groups, which we call A, B and C. The C-group contains the three last samples only, consisting entirely of herring of Icelandic origin. They were taken from catches in coastal waters after the end of the season in September (No. 38) and October (39—40). The A-group, which occurred chiefly in July, during the main fishing, comprised nearly pure Norwegian herring, while the B-group—mainly caught in August—seemed to be a mixture of both Icelandic and Norwegian types.

The maps on Figure 1 indicate the localities where the samples were caught. There are two maps, one for July and one for August (and September-October), and the "grouping" of the samples according to time and space is also shown. In the last two reviews of the north coast herring (Ann. Biol. VIII and IX) it was pointed out that elements of Icelandic origin were mostly found in coastal waters,

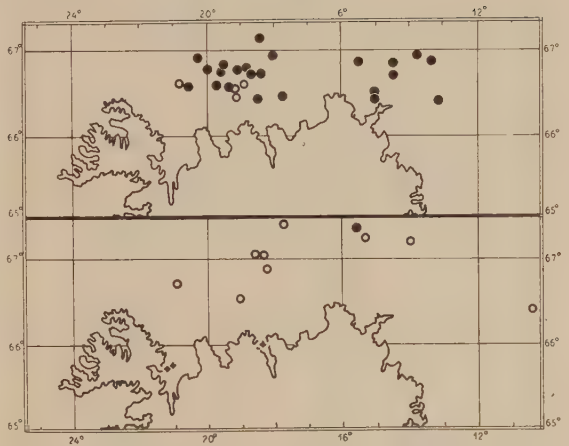


Figure 1. North coast herring 1953. Localities of sampling. ● = A-group, ○ = B-group, + = C-group. Above, July; below, August.

but in 1953 they could be traced far off shore. However, there was a difference in time, which can be seen on Figure 1.

In order to get a better idea of the three groups into which the samples have been divided we can consider Figures 2 and 3. In Figure 2 the size distribution has been plotted for each group separately. As usual the "real" north coast herring is the largest, and the Icelandic one the smallest, group B, which represents a mixture, maintaining an intermediate position. The same applies to the age, as shown on Figure 3. The A-group consists mainly of very old herring, and the C-

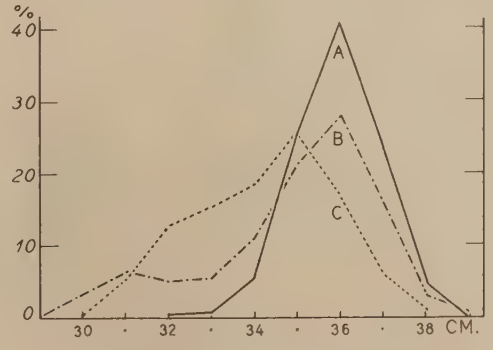


Figure 2. Diagram showing the length distribution in the three groups, A, B, and C.

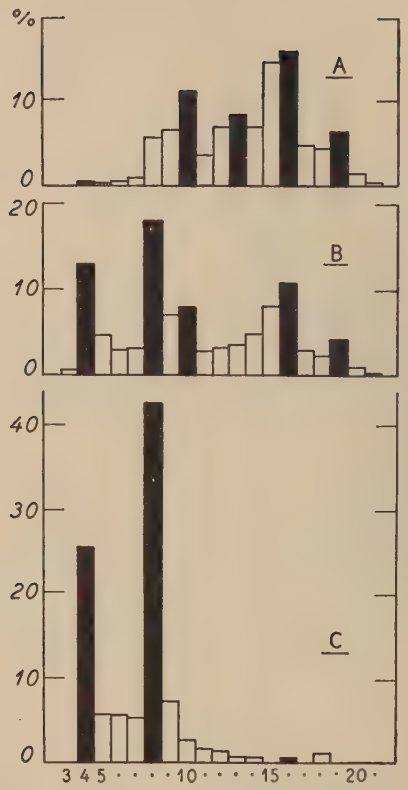


Figure 3. The age distribution in the three groups A, B, and C.

group of young ones, whereas the B-group maintains an intermediate position.

The size of the north coast herring in 1953 is shown in Table 1. Each group is shown separately, and those herrings which were measured only, were mostly fish which were tagged.

Altogether 12,310 fish were measured, and the average length proved to be 35.79 cm., even when the relatively small fish of the C-group and the B-group were included. This is a higher average size than in any earlier year, showing that the trend towards bigger fish from year to year, which started some years ago, is still being continued. In the years before 1945 there used to be more fish of 35 cm. length than in any other size-class, but now we find the maximum at 36 cm. and there are more fish of 37 cm. than of 35 cm. The small secondary maximum at 31 cm. is due to the occurrence of young fish of Icelandic origin which was indicated by the age composition of the groups and which will appear clearer when the age in the different tribes is considered. It is due to the influence of four-year-old fish of the spring-spawning type.

We will now consider the age composition of the stock as a whole and of the various tribes constituting it separately, which is outlined in Table 2 and Figure 4.

Table 1. Size of North Coast Herring in 1953 (‰).

cm.	A	B	C	Measured only	Total
40	—	1	—	+	+
39	3	4	—	4	4
38	43	26	7	76	63
37	238	159	58	283	257
36	407	280	168	365	358
35	249	212	252	175	194
34	51	109	185	37	51
33	4	55	155	13	19
32	2	50	124	17	20
31	2	64	51	23	24
30	1	36	—	7	9
29	—	4	—	—	1
Σ	1000	1000	1000	1000	1000
Number	2334	1300	297	8379	12310
Mean	35.95	34.87	34.23	35.94	35.79

Table 2. Age of North Coast Herring in 1953 (‰).

Age	Year-class	NN	NS	ISPR	ISUM	?[2])	Total
3	1950	—	—	12	—	—	2
4	1949	—	—	**376**	23	—	**68**
5	1948	—	2	85	62	8	21
6	1947	3	15	43	62	59	20
7	1946	2	32	22	92	59	21
8	1945	11	59	**352**	**528**	119	**130**
9	1944	29	140	62	103	186	68
10	1943	**80**	**244**	3	46	59	**92**
11	1942	10	115	12	23	85	33
12	1941	46	125	2	23	76	52
13	1940	61	86	29	13	172	60
14	1939	86	37	—	16	67	56
15	1938	**195**	46	—	3	34	**112**
16	1937	**228**	46	—	—	25	**130**
17	1936	67	30	2	—	34	40
18	1935	71	5	—	6	17	40
19	1934	**88**	19	—	—	—	**43**
20	1933	18	7	—	—	—	10
21	1932	3	2	—	—	—	2
22	1931	1	—	—	—	—	+
23	1930	1	—	—	—	—	+
Total		1000	1000	1000	1000	1000	1000
Number		1741	591	580	304	118	3334
?[1])		178	2		1	416	597
Grand Total		1919	593	580	305	534	3931
‰		565	175	171	89		1000

[1]) Scales not fit for determination of type.
[2]) Scales not fit for age reading.

In the Northern Norwegian tribe (NN) the same year-classes are present as last year, and nothing new has been added. The only difference is that the 1943 year-class is a little stronger now than a year ago, and the oldest predominant group which is 19 years old (1934), appears fainter than earlier. As to the NS-tribe it also applies that no new year-class has entered into the stock, but there is a considerable difference as regards the relative strength of the broods when compared with 1952. The main features are that the 10-year-old herring are clearly predominating, and there are fewer old fish. If the 12-year-old herring, which show relative dominance, are excepted, the same dominants appear in the NS-stock as in the NN-stock. But the NN-stock consists, as usual, of much older fish than the NS-stock.

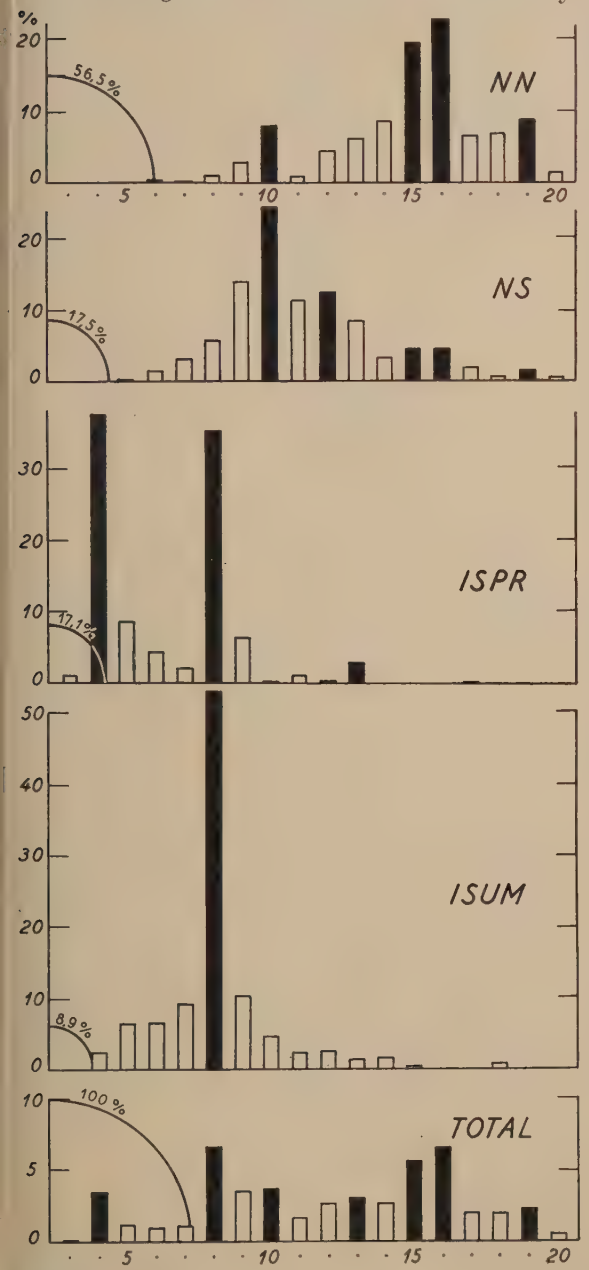


Figure 4. North coast herring 1953. Age distribution in the different tribes and the relative number of fish in each tribe (circles at left).
NN = North Norway type,
NS = South Norway type
ISPR = Icelandic spring spawners
ISUM = Icelandic summer spawners.

Turning now to the two Icelandic tribes, the spring spawners (ISPR), and the summer spawners (ISUM), it becomes at once evident that they have nothing in common with the other tribes as regards age composition. In the ISPR there are two strong and one weak dominants, representing the broods from 1949, 1945 and 1940. They all appeared last year as dominants, but the two first mentioned are much more predominating now than they were in 1952. The reverse is the case with the 1940 brood, which seems to be entirely disappearing at the age of 13 years. Last year predominating year-classes in the ISUM-stock were 4- and 7-year-olds, the first one being the stronger. In 1953 only the older one occurred as a dominant off the north coast, being now 8 years old. It was the only dominant here in this tribe, and a very strong one, contributing more than 50 % of the stock.

In the last column of Table 2, and at the bottom of Figure 4, the age composition of the whole stock is recorded. As was to be expected, there were many dominants, derived from the different tribes, as described above. There is no doubt that the failure of the fishery was due to the absence of the major part of the oceanic stock (tribes NN and NS), as was also the case during the preceding years. But in spite of this sparse occurrence they still yielded the greatest part of the catches. There was practically no fishing after they had disappeared in the beginning of August and their relative number in the samples also indicates the same, which can be seen from the following survey:—

NN = 56.5 %	74.0 %	
NS = 17.5 %		
ISPR = 17.1 %	26.0 %	
ISUM = 8.9 %		

The figures tell that the NN- and NS-herring made up three quarters of the total catch by number, but of course much more by weight. The number of vertebrae is shown in Table 3, in which a survey is given for each tribe separately.

Table 3. The Total Number of Vertebrae (VS) in the different Tribes of the North Coast Herring 1953.

VS	NN	NS	ISPR	ISUM	?	Total
59	22	11	7	3	6	49
58	531	165	155	58	128	1037
57	1132	346	357	193	317	2345
56	225	69	58	49	80	481
55	9	1	3	2	3	18
54	—	1	—	—	—	1
N	1919	593	580	305	534	3931
M	57.17	57.19	57.18	57.03	57.10	57.15
± m	0.02	0.03	0.03	0.04	0.03	0.01

The average number is slightly higher than last year, being 57.15 now against 57.13 in 1952. The number in the NS-tribe is considerably higher being 57.19 (57.12) and the same applies to the Icelandic summer spawner, having 57.03 vertebrae now instead of 56.89 last year. As a whole the tendency seems to go towards increased number of vertebrae during recent years.

Before leaving the racial characters we will consider the average number of vertebrae within each of the three earlier mentioned groups in relation to the stages of maturity. Table 4 shows clearly that there are considerable differences from group to group and from stage to stage.

It is evident that the A-group consists entirely of spring spawners except for 11 fish in stage V and VII. The difference between III and VIII $\left(\frac{M_1 - M_2}{\sqrt{m_1^2 + m_2^2}}\right)$ is quite negligible being 0.2 only. In the B-group the herring of stage VIII (and VII) must be summer-spawning, and the

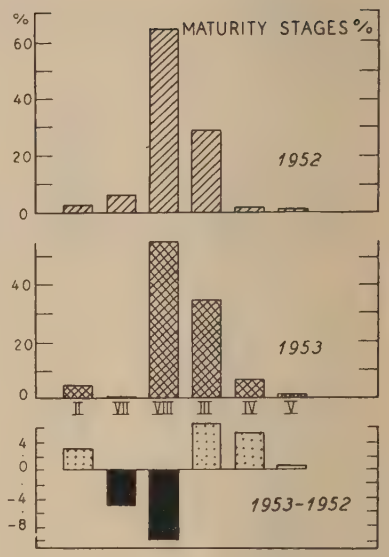


Figure 5. Maturity of north coast herring.

remainder spring-spawning. The difference between III and VIII here is significant: 3.5. Finally the C-group is a mixture of both types, but there are most summer spawners (II, III and VIII, 194 in number or 65.3 %).

The calculation of the maturity factor (MF), which represents the weight of the gonads as percentages of the total weight of the fish, in connection with the estimation of maturity stages was of particular interest in 1953. A comparison with 1952 revealed that the maturity was more advanced this year than at the same time in 1952. This is illustrated in Figure 5. It is evident that there were relatively fewer fish in stage VII and VIII and relatively more in III and IV than in 1952. This corresponds pretty well with the unusual fine condition of the herring, as shown by the fat content, which proved to be as follows during July:— 2.—10., 17%; 11.—16., 18.9%; 23.—31., 22.0%.

Table 4. The Number of Vertebrae according to the Stages of Maturity.

Mat. Stage	A-group N	A-group VS	A-group m	B-group N	B-group VS	B-group m	C-group N	C-group VS	C-group m
II	7	57.43	± 0.22	180	57.14	± 0.05	6	57.00	—
III	782	57.19	± 0.02	515	57.24	± 0.03	42	57.02	± 11
IV	30	57.23	± 0.12	105	57.20	± 0.07	93	57.27	± 0.06
V	10	57.00	± 0.23	—	—	—	10	57.20	± 0.20
VI	—	—	—	—	—	—	—	—	—
VII	1	57.00	—	6	57.00	± 0.23	—	—	—
VIII	1504	57.14	± 0.02	494	57.10	± 0.03	146	57.00	± 0.05
Total	2334	57.16	± 0.01	1300	57.17	± 0.02	297	57.10	± 0.03

This is considerably more than normal (14.0—19.5 % in July) and shows that the stock was advancing through the different degrees of condition, at least one or two weeks earlier than normally. In this connection it is very important to mention that in the spring of 1954 the herring arrived on the spawning ground in Norway considerably earlier than expected.

In accordance with better yields in 1953 than in 1952 a number of herring tags were returned from the reduction plants. The total records were these:—

From tagging in	Iceland	in	1948	1
»	»	»	1950	1
»	»	»	1951	9
»	»	»	1952	64
»	»	»	1953	75
»	»	Norway	1949	1
»	»	»	1950	1
»	»	»	1952	1
»	»	»	1953	1
»	»	Open Ocean	1951	1
		Total		155

It is of interest to note that 4 tags were found from Norway, and 1 from the open ocean, as compared with only 1 in 1952. This indicates that more "Norwegian" herrings have migrated into the area than it was the case in 1952, which fact is in good accordance with the somewhat better yields.

Á. Friðriksson.

North and North-East of the Faroe Islands. Occurrence of Herring.

The researches on the distribution of herring in the area north and north-east of the Faroes were carried out as in previous years.

R/S "Dana" operated in the area from the Faroes to east Iceland during the month of June; the fishery inspection vessel "Thetis" of the Royal Danish Navy carried out Asdic observations on the occurrence of herring and hydrographic observations in May, August and September; and a Danish fishing cutter in collaboration with a Faroese vessel began experimental fishing with floating trawl in December and continued this work during January 1954, securing samples of herring, hydrographic observations etc. for scientific use.

The distribution of herring was in 1953 similar to that observed in 1951 and 1952 in this area, especially during the summer time. During the summer the Atlantic water masses were however slightly warmer and the subarctic water masses slightly cooler than in 1952.

The herring shoals were as usual especially met with in the boundary areas of the Atlantic current and the East Icelandic Current.

In 1952 the herring occurred during the whole summer southwards to about 63° Lat. N. In August 1953, however, they were scarce south of 65° Lat. N.; later on (in September) the herring concentration increased south of this latitude.

A review of the research work carried out 1948—1953 is under preparation.

Å. Vedel Tåning.

Norwegian Sea.

The age composition in the samples of the Norwegian winter herring from the year 1953 is shown in Figure 6 (cp. Ann. Biol. IX, p. 168). The material is divided into the areas in which the samples have been caught. The large herring are caught in the districts north of Bergen, mainly during the first month after the arrival of the herring in Norwegian coastal waters. The spring herring are caught in the districts south of Bergen. Also in 1953 the younger year-classes are better represented in the spring herring samples than in the samples from the large herring. The strong year-class hatched in 1947 which in the 1952 spring herring constitutes about 30%, in 1953 constitutes about 32% of all spring herring examined. That means the recruit spawners from that year-class more than compensate for the death rate. In the large herring the 1947 year-class has been reduced

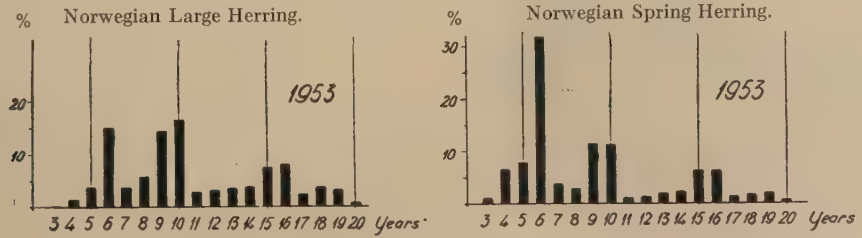


Figure 6. Age composition of samples.

from about 22 % to about 15 %. It looks as if the recruit spawners are almost lacking in the large herring. It is the year-classes from 1944 and backwards to 1933 that are responsible for the major part of the catch. Also in the spring herring samples the three-, four- and five-year-old herring are unusually sparsely represented. The 1949 year-class, which in 1952 looked very promising, is reduced in the samples from 1953 to a year-class below average. I will not try to explain the feature at this stage.

In the summer of 1953 extensive cruises were carried out with the R/V "G. O. Sars" in the Norwegian Sea, and the hydrographical conditions were mapped in collaboration with the Danish and Icelandic research vessels. The herrings were located by use of echo-soundings and from the "G. O. Sars" also by use of Asdic. The three research vessels met at Seydisfjord the 25. June and exchanged the material. In July the investigations were continued with "G. O. Sars" and the herring located were reported to the Norwegian herring fishing fleet, which had a very good season in the Norwegian Sea.

During the autumn two cruises were carried out in the Norwegian Sea to locate the herring before the shoals started on their spawning migration to the Norwegian coast. The conditions in the Skagerak were also investigated. The results will soon appear in a Norwegian publication.

FINN DEVOLD.

Tagging Experiments.

In Table 5 is shown the number of herring tagged in Norway in 1953 and the types of tags used:—

Table 5.

Category	Tagged amount and types of tags Internal (steel)	External (Lea)	Ext. & Int. (double)	Total
Large herring ...	10,086	—	999	11,079
Spring herring...	10,046	200	900	11,146
Fat herring.....	8,496	1000	260	9,756
Total.....	28,622	1200	2159	31,971

For all liberated herrings length measurements were taken. In addition scales were taken from the externally and doubly tagged herring.

During the cruises, a special apparatus for double tagging was constructed and tried out with success. This device, called "the tagging sluice", consists of four main parts:—

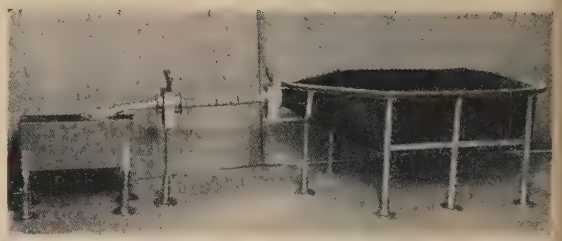


Figure 7. "Tagging sluice".

1. A container for herring and sea water,
2. a sluice with gates, through which the herring is led into a
3. pivoting cradle half-submerged in a
4. tagging container filled with sea water.

In the tagging sluice the herring may be tagged both externally and internally, untouched by hand and with full water supply. In Figure 7 is shown the latest design of the apparatus, which is made of plastic, stainless steel and rubber.

Both relatively and absolutely there are more recoveries in 1953 than in any one year before. In Table 6 is given a survey of the returns from the different experiments: —

Table 6.

Tagging Area		Tagged Year	Nos.	Type of Tag	Rec. 1953	% lib.
Norway.....	A	1948	6,018	Internal	17	0.28
Iceland.....	B	1948	7,475	—	9	0.12
Norway.....	A	1949	8,261	—	18	0.22
Norway.....	C	1950	9,085	—	10	0.11
Norway.....	A	1950	11,215	—	8	0.07
Norwegian Sea	D	1950	506	—	5	0.99
Iceland.....	B	1950	1,321	—	8	0.61
Norway.....	C	1951	10,241	—	25	0.24
Norway.....	A	1951	9,986	—	63	0.63
			355	Int. & ext.	1	0.30
			644	External	0	0.00
Norwegian Sea	D	1951	2,012	Internal	25	1.24
Iceland.....	B	1951	3,064	—	34	1.11
Norway.....	C	1952	10,295	—	19	0.18
Norway.....	A	1952	10,863	—	84	0.77
			898	Int. & ext.	10	1.11
			397	External	8	2.02
Norway.....	E	1952	7,971	Internal	18	0.23
			400	External	5	1.25
Iceland.....	B	1952	17,308	Internal	262	1.51
Norway.....	C	1953	10,080	Internal	14	0.14
			999	Int. & ext.	6	0.60
Norway.....	A	1953	10,046	Internal	20	0.20
			900	Int. & ext.	6	0.67
			200	External	2	1.00
Norway.....	E	1953	8,496	Internal	28	0.33
			260	Int. & Ext.	6	2.31
			1,000	External	15	1.50
Total.....	A-E	1948/53	150,276	Int. & ext.	726	0.48

A = Spring herring, B = N. coast herring, C = Large herring, D = Oceanic herring, E = Fat herring.

Table 7.

Year of recapture	A 1948	B 1948	A 1949	C 1950	A 1950	O 1950	C 1951	A 1951	O 1951	C 1952	A 1952	O 1952
1950.....	1.30	0.67	1.75	—	—	—	—	—	—	—	—	—
1951.....	0.74	0.35	0.98	0.57	0.30	2.03	—	—	—	—	—	—
1952.....	0.87	0.28	0.68	0.35	0.18	2.00	0.87	1.41	2.48	—	—	—
1953.....	0.74	0.36	0.61	0.33	0.21	2.10	1.08	1.77	3.14	0.52	2.00	4.19

A = Spring herring
B = North coast herring
C = Large herring
O = North coast herring and open ocean herring

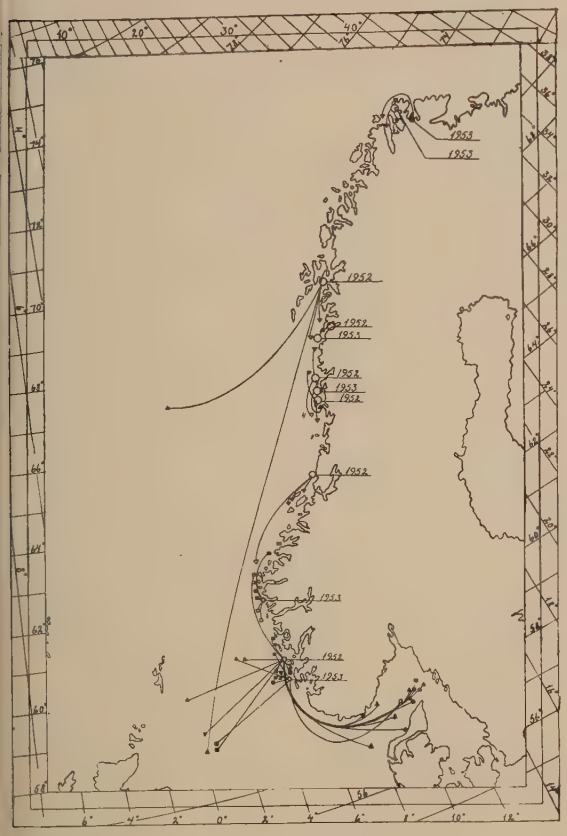


Figure 8.

In Figure 8 will be found an illustration of the distribution of tags with place records. There is less tendency for migration into the Skagerak area of the herring tagged this year, the fish were in general larger and older than in the previous spring (cp. Ann. Biol. for 1952).

In Table 7 are shown the per mille returns from the different experiments per million hl. from 1950 to 1953. Only internal tags returned from reduction plants with tested magnet separators are considered. One will notice that the returns from the Open Ocean and Iceland are relatively more numerous than from taggings in Norway except for 1948. Generally, the large herring taggings have yielded the fewer returns. Another striking feature is the rise in returns per unit of catch from 1952 to 1953 for most taggings. This means that herrings tagged in earlier experiments, must have dispersed temporarily and are now rejoining the main stock. This dispersal effect will complicate the stock-estimation and calculation of the fishing mortality based on the tagging figure to a very serious degree.

Olav Aasen.

B. North Sea and Adjacent Waters.

YOUNG STAGES

Autumn Spawned Herring Larvae in the Northern North Sea.

Scottish research vessels in 1953 again carried out a series of cruises to sample the herring larvae, spawned in the autumn, in the northern North Sea. The area sampled extended from 59°40′N. to 56°05′N., and from the Scottish coast to 0°30′E. The cruise periods were 16. September—4. October, 17.—24. October, 5.—15. November and 5.—20. December. Additional sampling was carried out, between 57°N. and 58°30′N., in August and September. The material from the December cruise has not yet been analysed.

The period during which active hatching was taking place coincided closely with that found in 1951 and 1952. A close grid of stations, centred off the Aberdeenshire coast

between 18.—20. August yielded no herring larvae. Six days later small larvae were taken in large numbers and continued to be taken on subsequent surveys, until the beginning of October. The main spawning centres again coincided closely with those of previous years; namely a coastal region from Girdleness to Buchanness within the forty fathom contour and over Turbot Bank. In 1953, there was also an extensive area of spawning to the east of Copinsay, extending eastwards to 1°30'W. A smaller spawning centre was located on Montrose Bank, whilst towards the end of the hatching period a small number of early larvae were taken off St. Abb's Head. In contrast to 1952, on none of the surveys was there any evidence of spawning having taken place on the banks in the Moray Firth.

The growth coefficient calculated from the 1953 data is an increase per day of 0.0057 in the logarithm of the length—a figure almost identical with the 1951 one.

The predominant direction of drift was again southerly. The products of the Orkney spawning had, by October, drifted in a south-easterly direction across the outer boundary of the Moray Firth. The distribution in November would seem to suggest that a part of these then turned in a westerly direction, along approximately 58°N. latitude, to reach as far west as Smith Bank; whilst another group continued south to reach the Buchan Deeps. Those spawned on Turbot Bank and off the Aberdeenshire coast, showed a south-westerly drift, resulting in a distribution in November from Berwick East Bank westwards to the Firth of Forth. Compared with 1952 the drift of this group seemed to be both more rapid and to have a more marked westerly component.

Spawning seems to have been slightly greater in 1953 than in the preceding year on the southern spawning grounds and more markedly so around Orkney. By October the difference between the two years, in the abundance of larvae derived from the southern spawning areas, was still quite slight, and may not even be significant. In November, however, these larvae were very markedly more abundant in 1953. The evidence would seem to suggest that in 1952 herring larvae underwent a very heavy mortality of around 16 % per day between the October and November cruises, whilst in 1953 mortality—up to November at least—remained more or less constant at around 4 % per day.

A. Saville.

Larvae at the Scottish West Coast.

Off the west coast of Scotland there exist important herring fisheries which operate almost continuously throughout the year. These fisheries are located in the Clyde and in the Minch. The herring caught in the Clyde are entirely composed of spring spawning fish, while in the Minch the stock is of mixed origin, both spring and autumn spawning fish being present.

The main spawning centres of the spring spawning herring in the Clyde and the Minch are known. No records, however, exist which provide information on the autumn spawning centres in this area. Often a good indication of the location of the spawning centres can be obtained from the position or positions at which herring in maturity stage VI are caught. In the Minch, however, herring seldom, if ever, appear in the catches in stage VI, and certainly never in any quantity. It is important to note that the development of the gonads of these autumn spawners can be followed through all stages up to and including stage V, followed after a short time by the appearance of spents in the catches.

During the period 28/9-53—15/10-53 a larval survey was carried out off the west coast of Scotland in the area between the island of Tiree and St. Bee's Head in the Irish Sea. An oblique haul, from near the bottom to surface, was made at each station with a 1 metre, 60 mesh silk net. The objects of the survey were twofold:—

1) To determine the position of spawning centres of autumn spawning herring by the presence of newly hatched larvae.
2) To investigate the movement, if any, of autumn spawned larvae from the Isle of Man spawning grounds into the South Minch and Clyde estuary.

The results of the survey are given in Figure 9. Two distinct areas of larval density were located, one in the Irish Sea, the other between the islands of Mull and Colonsay. Between these two regions there was a large area in which few larvae were taken.

The majority of the larvae obtained between the islands of Mull and Colonsay had recently hatched; this suggests that there was a spawning ground in the near vicinity. This contention is supported by the fact that during the cruise a nursery ground for young autumn spawned herring was located in Loch Linnhe. While

Figure 9. Corrigendum: The bottom line to read as follows:—
2/1 3/2 2/1 2/1 15/10 45/0 57/0 0/0.

it is admitted that the number of larvae taken per haul was small, it is believed that this was probably due to the fact that hatching was just beginning when the survey took place, and if these stations at which the newly hatched larvae were taken had been investigated later larger hauls would probably have been obtained.

Newly hatched larvae were also obtained in the Irish Sea close to Luce Bay, again suggesting that spawning had taken place close by and that this spawning is quite independent of the extensive autumn spawning which takes place to the south-east of the Isle of Man.

From this survey there is no indication of a movement of herring larvae from the Irish Sea into the South Minch and Clyde estuary. Later surveys, however, would have provided more information on this matter.

More extensive larval surveys will be carried out in 1954, which will cover the whole of the Scottish west coast, and from which it is hoped a more complete picture of the spawning centres for autumn spawning herring off the west coast of Scotland will be obtained.

I. G. Baxter.

Larvae in the Southern North Sea and the German Bight during March 1953.

During the cruise of the "Gauss"—carried out in March 1953 in the area off the Dutch and German coasts to 2°E. between 52 and 55°30′N.—56 catches with the Petersen young-fish-trawl were made and analysed for fish fry.

Figure 10 shows the distribution of herring larvae near the bottom. Only two surface hauls in the eastern part of the German Bight are included. The larvae in each catch were analysed in 5 mm. length groups.

Very small larvae (10—14 mm.) are numerous in the Southern Bight. Near the coasts of the West Frisian Islands and further north in a small area from Borkum Reef and Helgoland Ground to the White Bank the length groups of 15—19 and 20—24 mm. predominate.

The distribution and sizes of the herring larvae are in close agreement with those found in 1935—37, but in the light of the relevant conditions of wind and current during January —March 1953 it is extremely unlikely that the small larvae caught in the German Bight

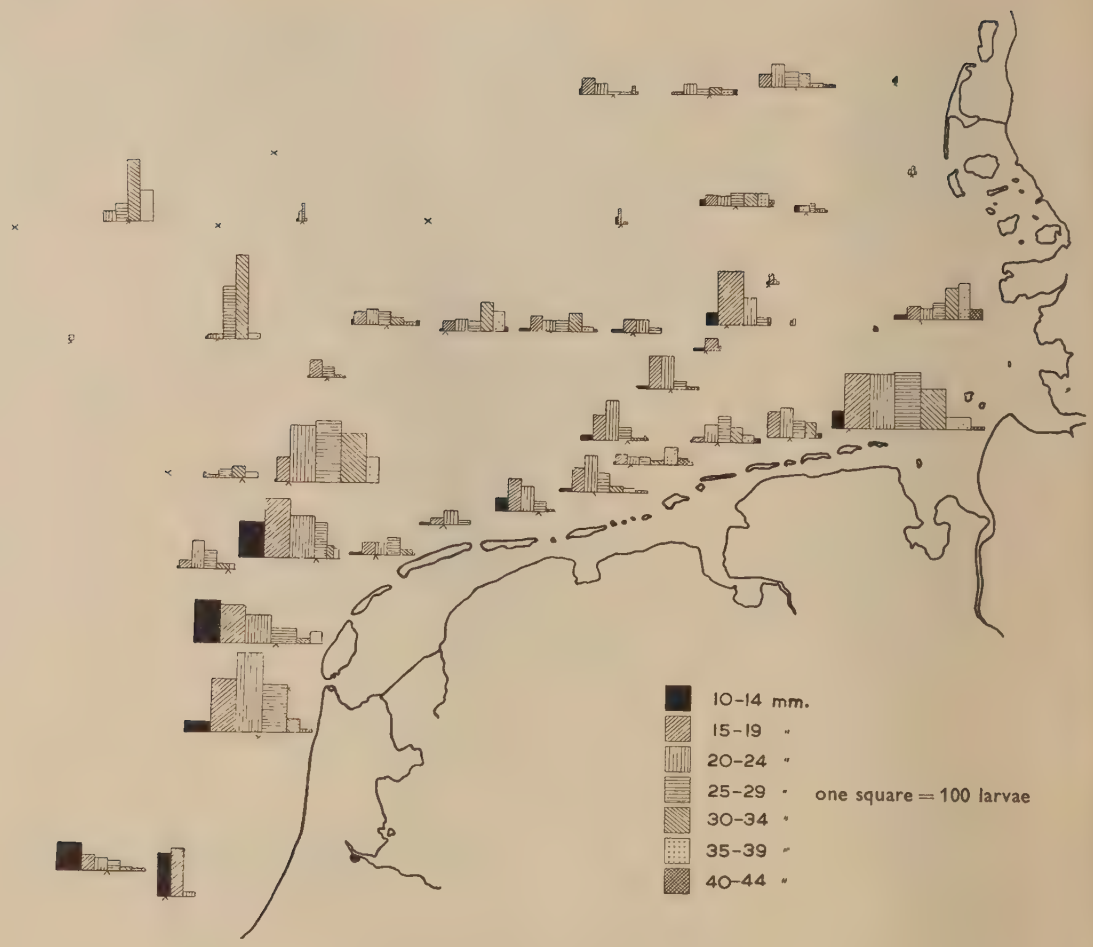


Figure 10. Distribution of herring larvae.

come from the well-known spawning places in the southern entrance of the North Sea. No suggestion as to their place of origin can be ventured at present.

In the region of the middle North Sea (Oyster Ground—Cleaver Bank—Outer Silver Pit—Clay Deep—Dogger Bank) the large larvae of 25—29 and 30—34 mm. presumably of Dogger origin are relatively abundant.

In the interior part of the German Bight herring larvae of all sizes were found.

Hj. Bohl.

0- and I-Group. Scotland 1952-1953.

Sampling of the 0- and I-group herring in east Scottish coastal waters was continued in 1952—53 and samples were examined from the drift- and ring-net fisheries, from research vessels' trawling and seining surveys, and from sampling with explosives.

The "halflin" herring fishery in the upper reaches of the Moray Firth was even more successful than in the previous winter and consistently high landings were made throughout the season which continued uninterrupted from September 1952 to March 1953 (cf. Ann. Biol. Vol. IX, p. 178). The total catch from the fishery was 38,885 crans. Because of difficulties in disposing of the herring, landings were restricted during most of the season to 25 crans per boat. The average catch per arrival over the whole season was 24 crans.

Details of the samples examined during 1953 are given in Table 8. Spring spawned herring of the 1951 brood made only a small contri-

Table 8. Length and Mean Vert. S. of 0- and I-Group Herring caught in the Inshore Waters off the Scottish East Coast in 1953.

(Numbers in brackets).

Locality	Date	Range cm.	Mean Length, cm.	Mean Vert. S.
		Autumn 1952 Brood		
Inverness Firth	June 1953[1])	7—8	7.16 (133)	56.34 (50)
	Sept. 1953[1])	7—8	7.44 (52)	56.25 (52)
		Autumn 1951 and Spring 1952 Broods		
Firth of Forth	Nov. 1952	8—16	11.29 (41)	56.34 (41)
	Mar. 1953[3])	11—17	13.95 (37)	56.19 (37)
	Apr. 1953	10—14	11.44 (27)	56.41 (27)
St. Andrews Bay	Nov. 1952	7—15	9.12 (302)	56.50 (50)
	Jan. 1953	13—17	14.81 (37)	56.70 (37)
	Mar. 1953	8—15	11.88 (362)	56.45 (177)
	May 1953	11—18	13.32 (306)	56.52 (73)
Aberdeen Bay	Oct. 1952	6—14	11.97 (36)	56.47 (34)
Inverness Firth	May 1953	13—20	14.88 (335)	56.53 (34)
	Sept. 1953[1])	16—22	18.69 (453)	56.47 (285)
		Autumn 1950 and Spring 1951 Broods		
Inverness Firth	Nov. 1952[3])	18—24	20.89 (246)	56.44 (239)
	Dec. 1952[3])	18—23	20.83 (240)	56.48 (232)
	Feb. 1953[4])	14—24	16.54 (1869)	56.88 (108)

[1]) Explosive samples. [3]) Drift-net samples.
[2]) Ring-net sample. [4]) Seine-net sample.
All others caught by trawl.

bution to the stocks of "halflin" herring sampled by drift-net in the Moray Firth but they constituted the major part of a seine-net sample from the same area. Differences in selectivity of the fishing gears may account for this contrast since herring of 16—17 cm., the modal length of the seine-net sample, are not represented in the drift-net samples.

The 0-group catches in 1952—53 were composed mainly of autumn spawned fish, the contribution by the spring brood of 1952 being small.

G. McPherson.

English East Coast.

0-group.

A number of beach-seine hauls were made at Lowestoft on 4. August 1953, in order to obtain 0-group herring for otolith study. The length distribution of the 0-group herring which were caught was found to be bi-modal; this was contrary to expectation and previous experience. 0-group herring caught at Lowestoft on 4. August 1947 and 20. July 1951, had a uni-modal length distribution, the mode being in the region of 7 cm. The modes on 4. August 1953, were at 3.78 cm. and 7.16 cm. the latter being the normal one which is associated with the spawning in the winter at Sandettié and the eastern end of the English Channel.

On examination, the herring comprising the group with a modal length of 3.78 cm. were all found to have metamorphosed and the vertebral counts were extremely low, the mean being 55.211. Many had a somewhat sprat-like shape, being about 2 mm. deeper than the normal Lowestoft 0-group herring of similar length. This was most noticeable in September and October after these herring had grown considerably.

A large number of herring similar to those described above were taken in beach-seine hauls at Sutton-on-Sea on the Lincolnshire coast on 9. August 1953, and a few were also captured in the same manner at Bridlington on the Yorkshire coast on 10. August 1953. This was the furthest north that these herring were found, none being taken in a further series of hauls at Scarborough on 13. August 1953. It therefore appears that these unusual 0-group herring were widely distributed along the English east coast in fairly considerable numbers.

Table 9 shows the percentage length distribution and some of the vertebral counts of 0-group herring caught at Lowestoft on 4. August, 5. September, and 2. October 1953, and at Sutton-on-Sea on 9. August. In calculating the mean vertebral number of the two groups of herring in each of these four samples, the vertebral counts in the half centimetre groups where there is considerable overlapping have been ignored. Apart from the difference between the mean vertebral number of the herring comprising the two modal groups in each sample, which is so marked, the increase in the modal length of the smaller herring at Lowestoft during the period 4. August to 5. September 1953, is surprising, being an increase of 2.29 cm., whilst the modal length of the larger herring increased by only 0.92 cm. This large increase in size of the smaller group between August and September may not, however, be a true growth increase; it may be due to a larger brood having replaced the earlier brood of small fish. Growth between 5. September and 2. October 1953 was extremely small by comparison being 0.08 cm. for the small herring and 0.25 cm. for the large.

Table 9. 0-Group Herring. Percentage Length Distribution with some Vertebral Counts.

	Lowestoft 4.8.53							Sutton-on-Sea 9.8.53							Lowestoft 5.9.53							Lowestoft 2.10.53							
	20 mins. before low water							2 hours after high water							60 mins. before low water							40 mins. before low water							
cm.	%	54	55	56	57	58	59	%	53	54	55	56	57	58	%	53	54	55	56	57	58	%	53	54	55	56	57	58	cm.
2.5—9	—	—	—	—	—	—	—	2.4	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.5—9
3.0—4	3.4	—	2	5	—	—	—	30.5	2	6	14	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.0—4
.5—9	7.4	5	19	12	2	—	—	32.0	1	2	14	13	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.5—9
4.0—4	3.7	6	10	4	1	—	—	11.6	—	—	11	11	—	—	3.1	—	—	4	—	—	—	.5	—	—	1	—	—	—	—	4.0—4
.5—9	2.7	2	6	2	—	—	—	3.9	—	1	5	11	1	—	2.3	—	1	2	—	—	—	1.9	—	1	4	—	—	—	—	.5—9
5.0—4	1.7	1	2	1	2	2	—	3.4	—	1	1	3	1	—	8.5	—	1	8	4	1	—	5.2	—	1	9	5	—	—	—	5.0—4
.5—9	3.8	—	—	3	4	—	—	2.0	—	1	1	5	1	—	11.6	—	1	11	5	—	1	11.4	—	2	14	6	1	—	—	.5—9
6.0—4	6.7	—	—	2	5	3	—	.5	—	1	—	—	—	—	16.3	3	11	13	13	1	—	18.5	—	4	25	10	1	—	—	6.0—4
.5—9	16.4	—	1	5	11	1	—	.5	—	—	1	—	—	—	6.2	1	2	9	7	1	2	7.6	1	5	8	4	—	—	—	.5—9
7.0—4	19.4	—	—	4	16	3	1	—	—	—	—	—	—	—	6.2	1	1	5	4	6	3	6.7	—	1	4	5	3	1	—	7.0—4
.5—9	15.0	—	—	5	9	3	—	.5	—	—	—	2	—	—	13.2	—	—	1	9	12	4	5.2	—	—	4	1	4	2	—	.5—9
8.0—4	10.0	—	—	—	4	1	—	1.5	—	1	—	1	3	—	18.6	—	—	—	5	12	1	17.2	—	—	—	12	18	6	—	8.0—4
.5—9	4.4	—	—	1	2	—	—	2.9	—	—	—	1	4	1	7.7	—	—	—	4	10	2	8.6	—	—	1	4	12	—	—	.5—9
9.0—4	2.4	—	—	—	—	—	—	3.9	—	—	1	4	4	—	3.1	—	—	3	6	7	2	6.7	—	—	—	6	9	—	—	9.0—4
.5—9	1.0	—	—	—	—	—	—	3.4	—	—	—	2	5	—	.8	—	—	—	2	5	2	4.8	—	—	—	3	4	—	—	.5—9
10.0—4	.7	—	—	—	—	—	—	1.0	—	—	—	—	2	—	.8	—	—	—	1	2	—	2.4	—	—	—	2	4	1	—	10.0—4
.5—9	1.0	—	—	—	—	—	—	—	—	—	—	—	—	—	.8	—	—	—	2	2	—	1.4	—	—	—	1	1	—	—	.5—9
11.0—4	.3	—	—	—	—	—	—	—	—	—	—	—	—	—	.8	—	—	—	—	2	—	1.4	—	—	—	1	2	—	—	11.0—4
.5—9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.5	—	—	—	—	1	—	—	.5—9

cm. 3.0—4.9	M = 55.211 S = 0.7714 S_m = 0.0885	cm. 2.5—6.9	M = 55.367 S = 0.8192 S_m = 0.0748	cm. 4.0—6.9	M = 55.196 S = 0.9753 S_m = 0.0966	cm. 4.0—6.9	M = 55.137 S = 0.6899 S_m = 0.0683
5.5—8.9	M = 56.893 S = 0.6770 S_m = 0.0739	7.5—10.4	M = 56.548 S = 0.7676 S_m = 0.1379	7.5—11.4	M = 56.729 S = 0.7179 S_m = 0.0733	8.0—11.9	M = 56.727 S = 0.6201 S_m = 0.0661

After 2. October only very small numbers of 0-group herring were caught in subsequent beach-seine hauls and it was concluded that with the approach of winter they had moved into deeper water.

R. J. Wood.

COMMERCIAL FISH

Young Herring South of Dogger Bank.

During recent years an intensive fishery for young herring developed within the fishing grounds south of Dogger Bank, in which Danish and German fishermen were equally interested. As these stocks are of great importance for replenishing the herring stocks in the southern North Sea, the German investigations dealt with these herrings.

The fishing ground was in 1953 within the area from 54°30′N. to approximately 56°N. and from 3°30′E. to 6°00′E., in depths of 30 to 50 m. Fishermen and scientists have known for a long time that young herring occur in this area. It was, however, not until the ever increasing demand for fish-meal and oil required more raw material that this fishery developed. The fishing season was from

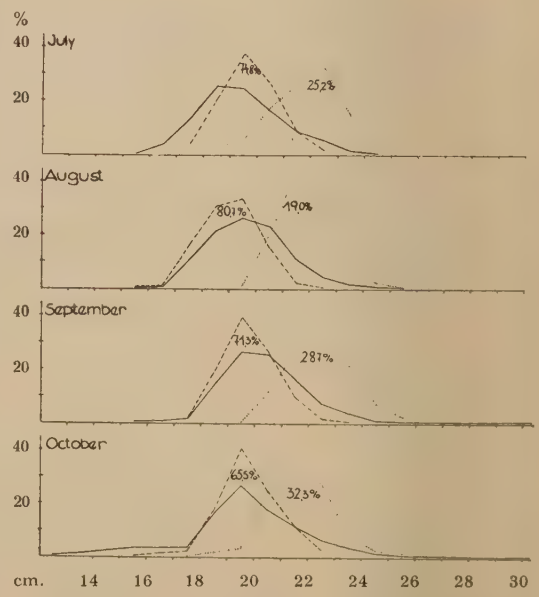


Figure 11. Length composition of herring samples.

——— young herring samples.
— — — — herring of the second year-class.
..... herring of the third year-class.

July until and including October. The total catch amounted to 26,000 tons.

Figure 11 shows the size composition of the catches of the several months (6,728 herrings) and the age-groups (2,520 herrings).

Mainly two year-classes of young herring occur predominantly in that fishery, viz. the 1950 and 1951 year-classes. The herring of two years of age take the main part of the catch, i.e., 65.5 to 80.7 %, whereas the share of the herrings of three years of age is only 19.0 to 32.3 %. Beside these two age-groups the catches included a small number of fish of four to six years of age. These occurred particularly in October. Some one-year-olds have also been found in October.

The average length of the two-year-olds increased from 18.2 cm. in July to 19.3 cm. in September, that of the three-year-olds increased from 21.2 cm. in July to 21.9 cm. in September. Thus the growth during that period is very small.

The average weight was 57.73 g. per herring during the whole fishing season.

The meristic characteristics indicate that North Sea stocks of autumn and winter spawning herring are present on these fishing grounds.

The occurrence of these herring shoals seems somehow to be connected with the cold bottom waters.

K. Schubert.

Young Herring from the Bløden Ground Area.

The work of 1953 covered the following items: a monthly survey of the hydrographical conditions and the plankton occurrences carried out with various research vessels, almost weekly samples from commercial catches for measurements and analyses of age and length composition, meristic characters, fat content and stomach content and as a supplement to the fishery statistical information on the localization of the fishery, the catch per day and per hour's trawling etc. have been collected regularly.

The fishery proved a good one in 1953. The total landings amounted to about 49,000 tons (including small amounts of whiting) which is an increase of about 17 % from the two preceding years. The spring fishery started earlier than usual and with rather good catches in January, but due to bad weather conditions in February the total catch of this season (6,200 ton) was about the same as in 1952. The spring fishery started as in previous years in the northern vicinity of White Bank in January, moving west during March to Clay Deep and ending up in the Silver Pit area by the last half of April. The autumn season started in June in the area off Esbjerg and was confined to the Bløden area proper during the following months. In September and October the principal fishing places were displaced somewhat north to the Tail End and Coffee Soil area. The main fishery ended about late October, but occasional large twin trawl catches made during November and December indicate that the herring does not leave the area entirely between October and January.

The results of the analyses (Table 10) and of supplementary market measurements are in good agreement with those obtained in 1952. The spring fishery was again mainly based on herrings with 2 winter-rings (one ring forming the edge of the scale) the same year-class (1950) which constituted the autumn fishery of 1952, but one year younger fishes—year-class 1951—made up notably higher percentages (about 40 % in numbers) than in preceding years. When the fishery leaves the Bløden area and moves west towards Clay Deep and Silver Pit, this I-group is eliminated from the catches and replaced by older maturing fishes, the II-group (year-class 1950) still being the dominant constituent. The meristic characters from the spring samples were rather uniform as regards the 1950 year-class having a notably high number of keeled scales (about 15.00). This also was the case with the 1949 year-class during the spring fishery of 1952 and seems to indicate that the II-group mainly belongs to a single spawning community, whereas the characters of the I-group, both in spring and autumn indicate a rather extensive mixture of youngsters from several autumn and winter spawning North Sea herring populations.

As usual the autumn fishery was based on I-group herrings (year-class 1951) this group making up 80—95 % of the specimens. As mentioned above their average sizes and meristic means are rather variable from sample to sample but it seems possible to show a certain relation between these characters and the bottom temperature on the fishing locality in question. As will appear from the account on the hydrography of the Bløden area (vide p. 90) the presence of a border be-

Table 10. Herring Samples from the Bløden Ground Fishery 1953 analysed for Meristic Characters.

Date	Year-class 1950 %	Av. Size	Av. K_2	Av. V.S.	Year-class 1951 %	Av. Size	Av. K_2	Av. V.S.	Year-class 1952 %	Av. Size	Av. K_2	Av. V.S.
Bløden Area												
17/1.....	50	19.6	15.00	56.60	45	15.7	14.73	56.69	0	—	—	—
9/2.....	0	—	—	—	100	13.7	14.81	56.65	0	—	—	—
1/3.....	73	20.2	15.08	56.64	22	14.7	14.68	56.56	0	—	—	—
5—8/3....	40	21.0	14.96	56.50	55	15.0	14.87	56.55	0	—	—	—
3/7.....	19	21.4	—	56.29	81	18.6	—	56.61	0	—	—	—
20/7.....	17	—	14.86	56.52	78	18.7	14.79	56.62	0	—	—	—
29/7.....	5	—	—	—	95	18.0	14.99	56.47	0	—	—	—
7/8.....	7	—	—	—	93	19.1	14.70	56.71	0	—	—	—
13/8.....	26	22.1	14.95	56.60	73	19.1	14.87	56.77	0	—	—	—
18/8.....	13	22.1	15.11	56.60	82	18.8	14.80	56.55	0	—	—	—
21/8.....	1	—	—	—	99	19.3	14.87	56.58	0	—	—	—
29/8.....	13	22.6	14.83	56.45	86	19.7	14.79	56.64	0	—	—	—
21/9.....	4	23.0	15.08	56.55	70	20.0	14.77	56.43	24	15.0	14.91	56.60
27/9.....	0	—	—	—	86	19.2	14.92	56.61	14	13.6	14.55	56.50
5/10.....	22	23.4	14.85	56.62	71	20.5	14.77	56.63	0	—	—	—
19/10.....	0	—	—	—	79	19.5	14.84	56.44	21	14.1	14.73	56.50
2/11.....	0	—	—	—	57	18.5	14.96	56.55	43	14.8	14.66	56.48
23/11.....	4	—	—	—	96	21.0	14.71	56.59	0	—	—	—
Silver Pit												
15/3.....	72	20.2	14.85	56.62	5	16.4	—	—	0	—	—	—
27/3.....	83	20.1	15.06	56.59	2	—	—	—	0	—	—	—
Grådyb (off Esbjerg)												
15/12.....	2	—	—	—	11	—	—	—	87	11.4	14.88	56.47

tween two water masses of different temperature is the most significant feature during the late summer and autumn, making the Bløden herring very convenient for the study of temperature relations. Our material is not yet ready for publication, but we feel justified in stating that fishes with high V. S., low K_2 and high average size seem mainly confined to the cold bottom layer in the northern and central parts of the area, while fishes with lower V. S., higher K_2 and of smaller average size are mainly caught on the "warm side" of the border. Samples from the intermediate zone (10°—12°C.) show an intermediate position according to meristic characters and size. Thus the broad outlines indicate young herrings of a northern North Sea type meeting herrings of a southern type where the high bottom temperature gradient along the southern edge of the autumn spring-layer provides a mixing zone and a border between both. Calculations of L_1 seem at present to confirm this hypothesis and we hope that the work of 1954 will bring up the distinct pattern in this connexion.

The notably higher percentages of I-group fishes contained in the spring samples compared with the very good autumn season based on this group indicate the possibility of prediction. This will be further confirmed if the 1951 year-class eventually proves to be rather strong when entering the different spawning shoals of the North Sea in 1954 and 1955.

E. Bertelsen and K. Popp Madsen.

Scottish Research Work.

A. Fisheries.

North Sea.

As in 1952, landings of herrings at east Scottish ports in 1953 were first made in Aberdeen and Peterhead from the north-eastern North Sea, in the region to the east of the Fladen Ground in late March. This fishery, conducted principally by a small fleet of English drifters, operated on these grounds until late June, after which it gradually moved southwards, and in August was centred to the south of Aberdeen. It persisted until mid-September.

The main drift-net fishery from the Scottish drift-net ports, Fraserburgh and Peterhead, commenced in late April on the customary

Table 11. East Coast and Shetland Herring Landings.

Drift-Net

	Landings (crans)				Arrivals				Average catch per arrival[1]) (crans)			
	1950	1951	1952	1953	1950	1951	1952	1953	1950	1951	1952	1953
Fraserburgh.....	70,478	95,073	188,207	213,285	4913	7907	8468	9790	14.3	12.0	22.2	21.8
Peterhead.....	27,922	42,581	106,405	124,762	2164	3081	4072	4899	12.9	13.8	26.1	25.5
Lerwick.....	53,110	31,463	49,180	15,666	3361	1916	2415	1345	15.8	16.4	20.4	11.6
Wick.....	7,803	22,122	5,994	5,345	509	910	194	387	15.3	24.3	30.9	13.8
Aberdeen.....	31,644	31,218	62,274	72,217	546	665	915	1183	58.0	46.9	68.1	61.0

Trawl
(Aberdeen and foreign vessels combined)

	Landings (crans)				Hours fishing				Landings per 100 hours (crans)			
Fladen.....	10,375	16,425	18,983	8950	6123	7111	9773	3382	169.4	231.0	194.2	264.6
Gut and southwards.....	—	—	5,043	8976	—	—	1363	2391	—	—	370.0	375.4

[1]) These figures not adjusted to 100 nets per haul. Each arrival at Aberdeen represents, on average, 2 hauls. Arrivals at other ports usually only one haul.

grounds, and was carried on within a radius of 80 miles from the ports until the third week in September. The fishery from Lerwick, in the Shetlands, did not commence until mid-May, and because of the scarcity of fish only lasted until the third week in August. Owing to the failure of the fishery in this area, a small number of drifters landed herring at Wick from neighbouring grounds in July.

A small number of Scottish trawlers from Aberdeen fished for herring on the Fladen and Gut grounds between late July and the end of October, and a number of landings of herring from these grounds was also made in Aberdeen by Swedish and German trawlers.

The total landing statistics for each of these fisheries in 1953, together with those for the years 1950 to 1952, are given in Table 11, and the detailed statistics of catch and effort, on a regional basis, are given for the fisheries from Fraserburgh, Peterhead and Lerwick in Charts 1—10. Charts 1—5 give the number of hauls made in each "10 mile square" (10′ latitude by 20′ longitude) in each month, and Charts 6—10 give the corresponding average catch per haul per square, calculated on the basis of 100 nets per haul.

These statistics show that the large increase in yield and in average catch in 1952 over the previous two years in the major drift-net fishery from Peterhead and Fraserburgh was maintained in 1953. Total effort and yield were approximately 15 % higher than in 1952, and the average catch was only slightly below the 1952 value. The total landings and average catch at Lerwick, on the other hand, were much smaller than in previous years. Although the fishing effort on the Fladen Ground was much reduced in 1953, the catch per-unit-of-effort was higher than in previous years, but it remained substantially lower than that for the more southern grounds.

The area distribution of effort and catch in the Fraserburgh and Peterhead fishery was approximately the same in 1953 as in 1952. In May and June the most productive grounds were mostly outside a radius of 40 miles from the ports, but in July, August and September, heavy landings came from the more coastal regions. In September 1953, very heavy landings of spawning herring were taken on "Turbot Bank" in statistical square D13. This spawning fishery was much more productive than in the previous year.

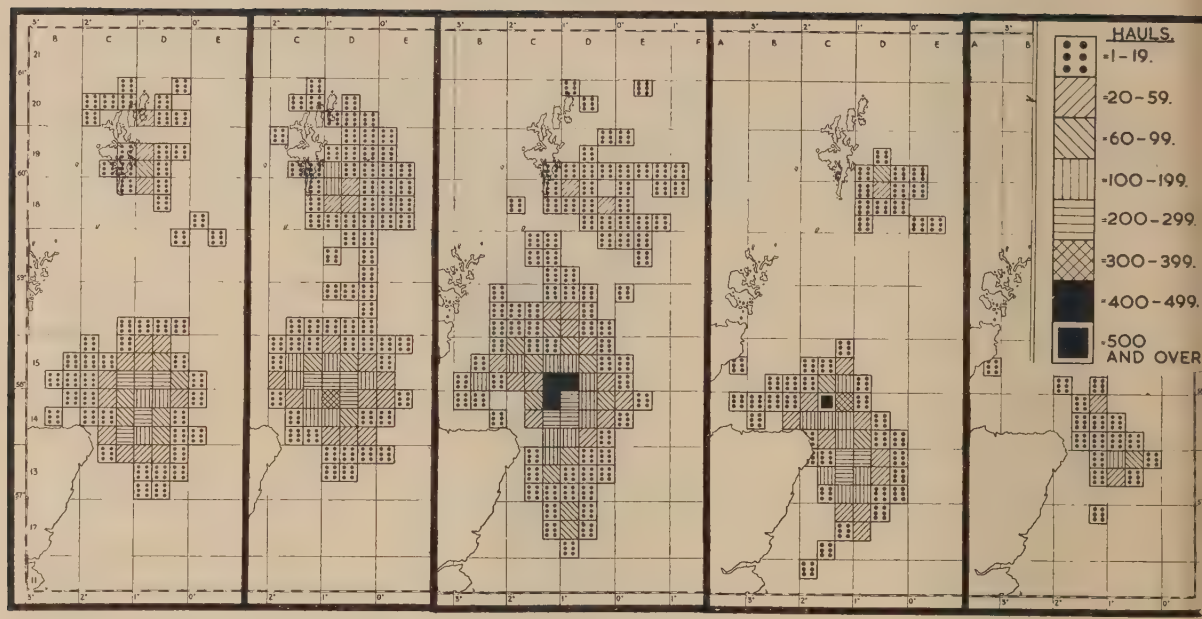
Charts 1 to 10 illustrate clearly the very marked fall in productivity of the Shetland grounds after May, particularly within a 40 miles radius of Lerwick.

B. Length, Age, and Racial Composition of Samples.

North-eastern North Sea.

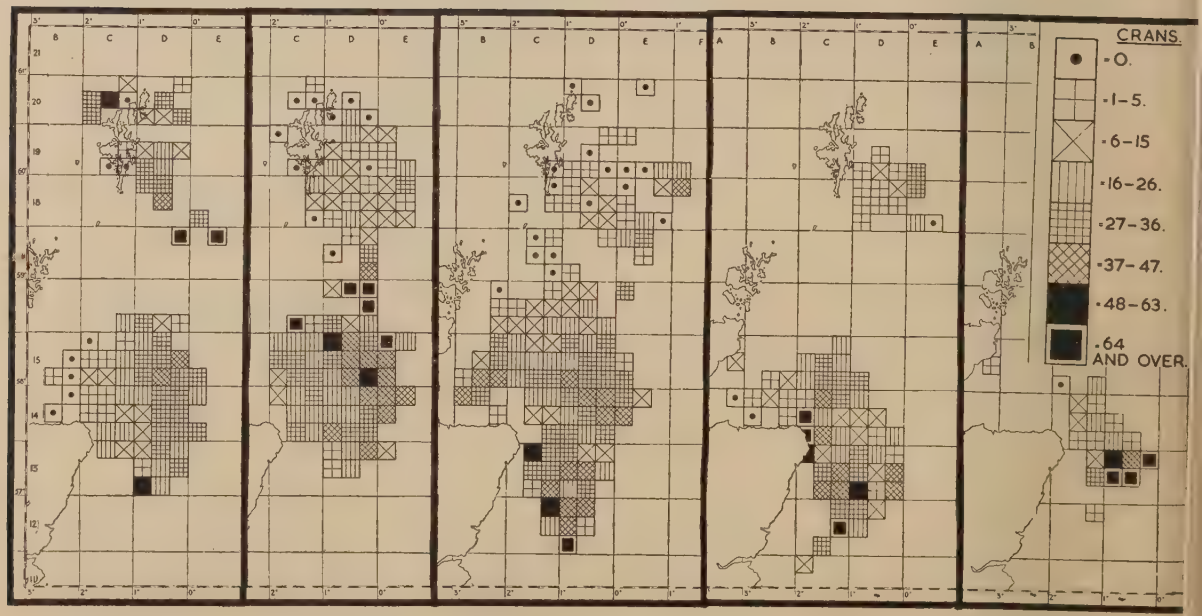
Four samples of herring were taken from the drifters working in the area to the east of the Fladen in April and May 1953. The length and age compositions of these samples are given in Figure 12, and their maturity and Vert. S. characteristics are given in Table 12.

Number of Hauls.



Charts 1—5.

Catch per Haul.



May June July August September

Charts 6—10.

Table 12. Maturity and Racial Characters—North-Eastern North Sea.

Date of capture 1953	Position of capture from Aberdeen	A. Percentage Maturity (all Age-Groups) Maturity stage I	II	III	IV	V	VI	VII and VII-II	No.	B. Vert. S. (Actual Numbers — all Age-Groups) 55	56	57	58	59	Mean
8/4	190 miles NE. × E.	1.6	8.8	1.2	—	—	5.2	83.2	250	9	107	118	12	—	56.54
21/4	200 miles ENE....	10.4	4.8	0.8	—	—	0.4	83.6	250	11	103	119	10	—	56.53
27/4	123 miles NE. × E.	4.6	5.1	—	—	—	—	90.3	197	3	84	96	10	—	56.59
15/5	170 miles NE. × E.	10.4	19.6	—	—	—	—	70.0	250	4	123	107	13	1	56.53

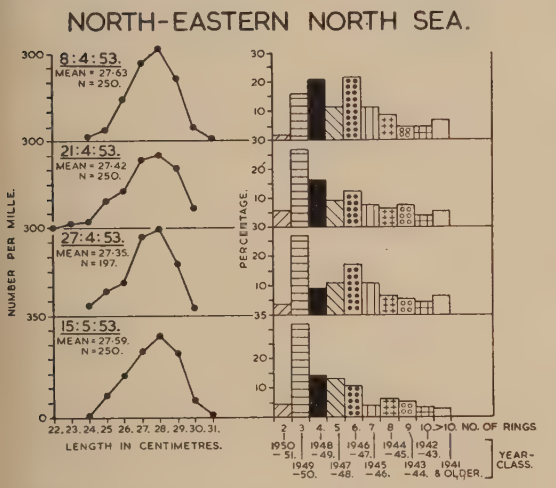


Figure 12. Length and age compositions of north-eastern North Sea drift-net samples. April-May 1953. (Length frequencies unsmoothed).

These data indicate that the population sampled on these grounds was composed mainly of recovering spent autumn spawners, with members of the year-class hatched in autumn 1949 predominating. This year-class was the one which predominated in the catches in the main Scottish east coast drift-net fishery in 1952 (Ann. Biol. Vol. IX) and which, as will be seen, reappeared on these grounds in large concentrations in 1953. The year-class 1946—47, with 6 winter-rings, was well represented in all four samples; this age-group also appeared prominently in the Shetland fishery in 1953, and at the beginning of the season in the northern part of the area fished from Fraserburgh.

The characters of the fish sampled from this region in 1953 contrast sharply with those possessed by a single sample taken in 1952,

Table 13. Maturity and Racial Characters—North-East Coast and Shetlands.

A. Percentage Maturity (all Age-Groups)

Maturity Stage	Fraserburgh Ap.	M.	J.	Jy.	Au.	S.	Peterhead Ap.	M.	J.	Jy.	Au.	S.	Lerwick M.	J.	Jy.	Au.
I.....	6.0	**25.0**	**32.5**	21.8	1.6	0.7	14.5	**32.3**	**36.6**	**24.9**	5.8	1.1	1.3	5.2	**25.8**	3.3
II.....	10.0	**27.4**	**40.5**	**22.4**	2.7	1.3	11.3	21.3	**42.0**	**32.0**	7.6	—	**34.7**	**52.9**	**30.7**	**31.9**
III.....	0.7	0.8	7.4	19.7	3.6	3.7	0.4	0.3	5.7	15.5	4.5	2.8	3.8	15.0	19.3	11.3
IV.....	—	—	1.9	**22.0**	13.3	15.8	—	0.2	1.1	12.5	13.7	8.7	0.5	3.2	9.2	14.3
V.....	—	—	0.2	9.1	**31.7**	**24.9**	—	—	0.1	10.4	**25.2**	**20.6**	—	—	3.0	7.8
VI.....	—	—	—	0.2	**23.3**	7.4	—	—	—	0.9	18.0	16.4	—	—	0.3	1.9
VII & VII—II.	**83.3**	**46.8**	17.5	5.0	**23.9**	**46.3**	**73.8**	**45.9**	14.5	3.8	**25.3**	**50.4**	**59.8**	23.7	11.7	**29.4**
No. of Fish	400	1093	898	1143	1048	298	248	1083	878	1101	1008	286	395	834	972	778

B. Vert. S. (Actual Numbers — all Age-Groups)

No. of Vertebrae																
54.....	—	—	1	2	1	—	—	2	2	1	—	—	—	—	1	—
55.....	16	37	40	45	36	8	4	33	28	44	52	12	11	27	31	20
56.....	179	450	316	464	509	150	110	438	348	437	483	151	198	334	348	193
57.....	171	511	446	543	449	123	110	503	433	523	425	112	160	392	481	263
58.....	21	64	62	57	35	12	16	75	48	67	36	6	18	63	90	40
59.....	—	2	1	1	4	—	1	1	2	1	1	—	—	2	4	4
Mean.....	56.51	56.57	56.61	56.55	56.48	56.47	56.59	56.59	56.58	56.57	56.45	56.40	56.48	56.61	56.67	56.64
No. of Fish	387	1064	866	1112	1034	293	241	1052	861	1073	997	281	387	818	955	520

Ap. = April, M. = May, J. = June, Jy. = July, Au. = August, S. = September.

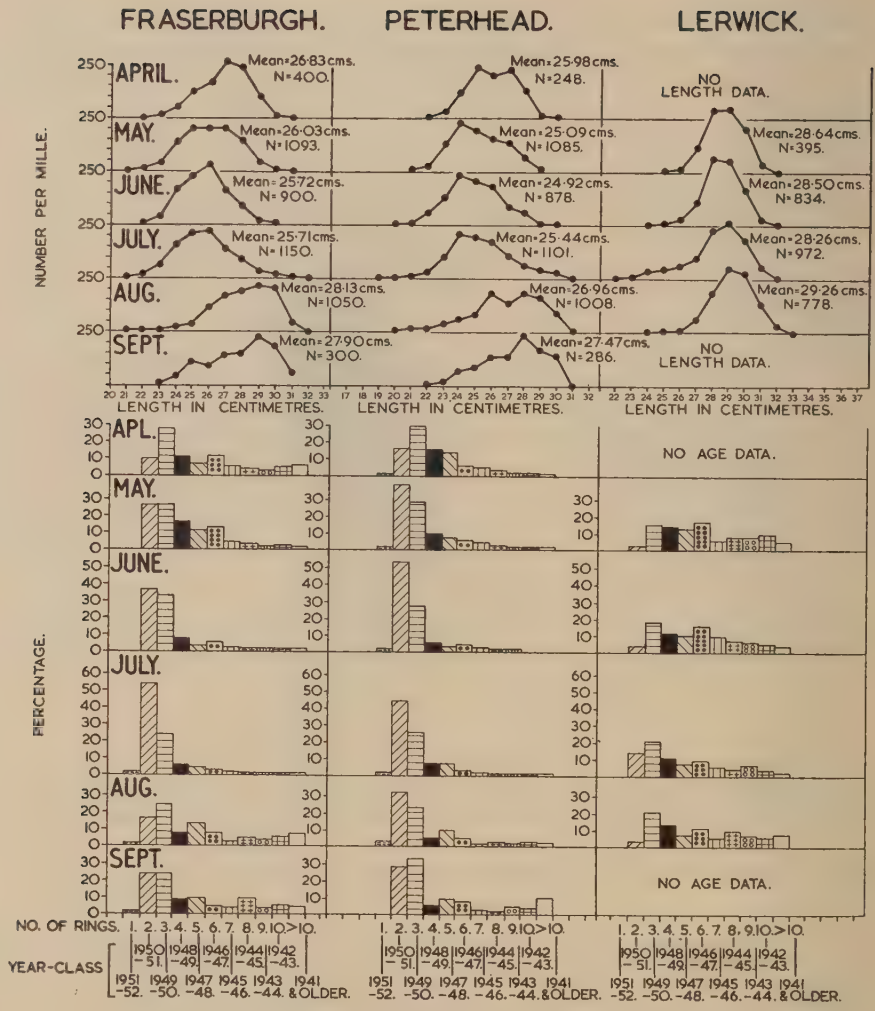


Figure 13. Length and age composition of north-east coast and Shetland drift-net herring samples. April-September 1953. (Length frequencies unsmoothed).

when spring spawners predominated (Ann. Biol. Vol. IX). However, they agree with those found in the 1951 and earlier samples (Ann. Biol. Vols. VII and VIII). It is evident that this area may yield herring of mixed origin, especially at its eastern extremity, bordering the Norwegian deeps where spawning grounds for spring herring are located.

North-east coast and Shetland.

Sampling was carried out intensively throughout the drift-net fishing season at Fraserburgh, Peterhead and Lerwick. The length and age compositions of herring sampled each month at these ports are presented in Figure 13, and the maturity and Vert. S. data are contained in Table 13.

Again, the most striking feature of the stock was the appearance of an abundant two-year-old class (hatched autumn 1950—spring 1951) on the north-east coast grounds in 1953. This brood was most prominent in the June and July samples from both east coast ports, when it constituted over 50 % of the total fish sampled. The three-year-old brood (hatched autumn 1949—spring 1950), which first appeared as an abundant recruit brood in the catches in 1952 (Ann. Biol. Vol.

IX) also appeared in abundance in the area in 1953. This brood and the new two-year-old recruit brood made up almost 80 % of the total catch in June and July.

The stock was composed mainly of autumn spawning herring, although the two-year-old recruit brood appeared to contain a proportion of spring spawned fish, during the period April to July. This is indicated by the mean vertebral counts for this age-group in the Fraserburgh and Peterhead samples, which were as follows: —

April	= 56.64 (86)
May	= 56.63 (408)
June	= 56.66 (456)
July	= 56.55 (650)
August	= 56.54 (314)
September	= 56.49 (102)

The mixed racial composition of the members of the recruit brood was also recognized in the samples from the east coast fishery in 1952 (Ann. Biol. Vol. IX), and it was found possible to separate the spring and autumn spawned individuals by the nature of their otoliths. It was also found that the mean vertebral counts of the recruit brood at the beginning of the fishing season (May and June), when the greatest proportion of spring spawners was present, corresponded closely with the values obtained for members of the same year-class taken in the previous winter as one-ringed fish in the Moray Firth and Firth of Forth "halflin" fishery. Samples taken from these fisheries between October 1951 and April 1952 gave mean vertebral counts between 56.56 and 56.70, (Ann. Biol. Vol. IX, p. 179), which indicate an admixture of spring and autumn spawned progeny, and these values correspond closely with the mean counts obtained for this brood in the April to July samples in the open sea fishery in 1952. These data, together with the close correspondence from year to year between the size of the catch from the "halflin" fishery in the upper Moray Firth and the abundance of the recruit brood in the east coast fishery, suggest that the major sources of recruits to the east coast drift-net fishery are the Moray Firth and Firth of Forth nursery grounds.

The mean vertebral counts of the three-year-old herring sampled in 1953 (year-class 1949—1950) were lower in May and June than were those observed for the same year-class (as two-year-old herring) in the same months in 1952. The counts for this year-class, from the samples so far worked up in 1953, are given below together with those recorded in 1952.

	1952	1953
May	56.70 (314)	56.51 (334)
June	56.62 (445)	56.52 (313)
July	56.55 (267)	56.56 (317)
August	56.51 (158)	56.40 (361)
September	56.52 (69)	56.35 (113)

Otolith analysis confirms the above indication that the spring spawned component of this brood did not reappear in such large numbers on the east coast grounds in 1953.

Shetland.

The two-year-old class failed to appear in large numbers in the Shetland area during the 1953 season. Together with the failure of the three-year-old brood to invade this area in the quantities expected this accounted to a large extent for the extremely poor fishery there.

Otolith analysis showed that the herring in the Shetland samples in 1953 comprised a mixture of spring and autumn spawned fish. Spring spawners made up a substantial part of the stock of two- to four-year-olds, but the older broods were mainly maturing autumn spawners in maturity stages III to V. The approximate proportions of the two spawning types in each of the age-groups I—VIII as judged by otolith analysis, and the mean vertebral counts for each spawning type, are given below.

		Spring Group		Autumn Group		
Year-Class	Age	%	Mean Vert. S.	%	Mean Vert. S.	Number analysed
1950/51	2	60	57.030	40	56.660	166
1949/50	3	45	57.010	55	56.509	436
1948/49	4	37	57.022	63	56.497	252
1947/48	5	15	56.964	85	56.555	155
1946/47	6	13	57.026	87	56.510	303
1945/46	7	17	56.850	83	56.560	116
1944/45	8	16	56.865	84	56.400	144

A number of the spring group were large herring with otoliths and scales characteristic of "Norwegian" herring.

Fladen and Gut.

The length and age compositions of the samples taken from vessels fishing on the Fladen Ground and the Gut in September and October are presented in Figures 14 and 15;

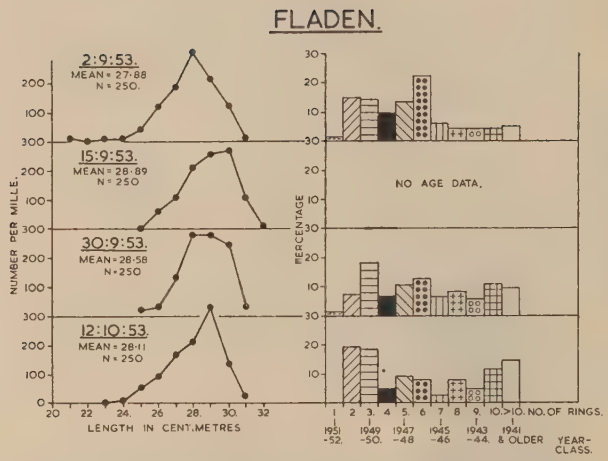


Figure 14. Length and age compositions of Fladen herring trawl samples. September-October 1953. (Length frequencies unsmoothed).

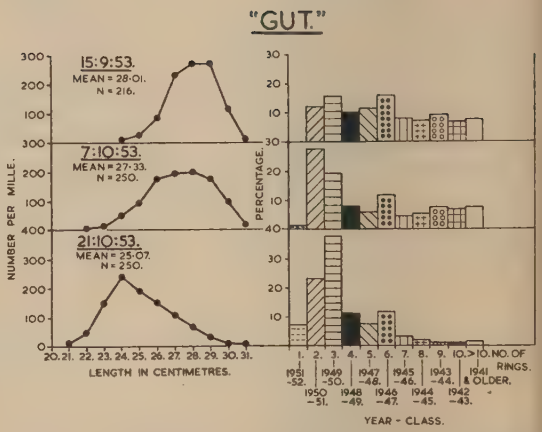


Figure 15. Length and age compositions of "Gut" herring trawl samples. September-October 1953. (Length frequencies unsmoothed).

the maturity and Vert. S. data are given in Table 14. The Fladen material shows the same general trends in stock composition as were revealed in the 1952 analysis. The stock was composed principally of autumn and late autumn spawners. The data show a marked change in percentage maturity between the samples taken on 2. and 15. September: the interval between these sampling times corresponds with the period of intensive spawning on the neighbouring banks off the Scottish east coast, and it is very evident that the main part of the stock on the Fladen Ground in the second half of September and in October was derived from the east coast spawning grounds.

It is interesting that the six-year-old brood, which appeared prominently in the Coral Bank and Shetland samples earlier in the season, also occurred as a prominent brood on the Fladen Ground in September.

The most striking feature of the material analysed from the Gut area was the presence in October of a group of small herring with a very low vertebral count and with maturities which suggested that they belonged to a winter or spring spawning community. An analysis of otoliths showed that two groups of herring could be distinguished, those with otoliths having the characteristics of the main body of North Sea autumn spawners, and those with a winter/spring otolith. The two groups were present in the sample in approximately equal proportions, and gave mean vertebral counts of 56.55 and 54.94 respectively. The autumn group were mostly in maturity stages IV—VII, while the winter/spring group were

Table 14. Maturity and Racial Characters—Fladen and Gut.

Date	Position in miles from Aberdeen	A. Percentage Maturity (all Age-Groups) Maturity Stage I	II	III	IV	V	VI	VII and VII-II	No.	B. Vert. S. (actual Numbers — all Age-Groups) 53	54	55	56	57	58	59	Mean
1953	Fladen																
2/9	100 NE. × E.	10.4	2.4	**31.6**	**35.2**	15.6	2.8	2.0	250	—	—	8	112	116	14	—	56.54
15/9	100 NE. × E.	4.4	2.4	8.8	19.2	3.2	0.8	**61.2**	250	—	—	9	110	113	12	—	56.52
30/9	105 ENE....	0.8	7.6	10.8	2.8	0.8	5.2	**72.0**	250	—	—	10	100	123	11	—	56.55
12/10	100 ENE.....	4.4	1.6	2.4	3.2	3.2	—	**85.2**	250	—	—	15	119	101	9	6	56.49
	Gut																
15/9	140 E. ½ S....	5.0	3.2	13.8	13.3	**29.9**	**21.6**	12.4	216	—	2	6	96	94	14	—	56.53
7/10	160 SE. × S..	12.8	1.2	15.2	17.6	16.4	4.0	**32.8**	250	—	—	17	84	112	21	1	56.60
21/10	140 S. × E...	12.8	**27.6**	**22.4**	6.0	4.8	0.8	**25.6**	250	**2**	**27**	**60**	**83**	**72**	—	—	**55.84**

Table 15. West Coast Herring Landings.

	Drift-Net					
	North Minch			South Minch		
	Landings (crans)	No. of Arrivals	Landings per Arrival (crans)	Landings (crans)	No. of Arrivals	Landings per Arrival (crans)
1951	101,771	7,200	14.1	23,053	773	29.8
1952	149,456	8,526	17.5	23,255	796	29.2
1953	181,254	8,030	22.6	15,915	442	36.0
	Ring-Net					
1951	28,077	953	29.5	48,818	1,982	24.6
1952	20,195	904	22.4	32,717	1,159	28.1
1953	23,508	1,074	21.9	52,451	1,069	49.1

in stages I—V (90 % in stages II and III). The group of spring herring in the North Sea which these most resemble are those inhabiting the coastal regions of the eastern and southern parts of the North Sea.

The other samples taken from the Gut area revealed the same general characteristics as the east coast samples, i.e., dominance of the two- and three-year-old broods, and the persistent prominence of the six-year-old brood.

West Coast.

Minch. In the Minch, as in recent years, the herring fisheries were in operation almost continuously throughout the year. A successful winter fishing (January-March), particularly in the North Minch, made an encouraging start to 1953. At the beginning of the summer fishery (April-September) catches were poor, but by the end of July landings had greatly improved. The autumn fishery (October-December) was exceptionally productive over the whole of the Minch fishery. The annual herring landings in the Minch from 1950—53 are given in Table 15. The overall total yield of the separate fisheries in the Minch in 1953 considerably exceeded the values obtained for the three previous years and, with the exception of the North Minch ring-net fishery, the catch per-unit-of-effort showed a marked improvement over the previous year.

The length and age composition data of the herring sampled in the North and South Minch are given in Figures 16 and 17 and the maturities and mean Vert. S. for different maturity stages are presented in Table 16.

As in previous years the North Minch data are from drift-net samples, while the South Minch data are from drift-net (January) and ring-net (February and November) catches.

The maturity and Vert. S. data indicate that the herring stock on all grounds throughout the year was predominantly an autumn spawning one, which is similar to the results obtained in 1951 and 1952. In the North Minch, the age data show that herring of the 1949—50 brood (three-year-olds) completely dominated the catches during the first part of the year.

During May, however, herring of the 1950—51 brood (two-year-old) began to appear in the catches in considerable numbers, and from June onwards it is evident that they predominated in the samples. Racial analysis of this brood suggests that they are mainly composed of autumn spawning herring.

Clyde. The herring fisheries in the Clyde in 1953 were again poor. Samples taken in the upper reaches of the Firth during the summer and in the outer reaches during the winter showed that the upper Firth fishery was centred mainly on adolescent spring spawning herring of two and three years of age, while the outer Firth stock was of young spawners from the Firth with an admixture of older spawners from other sources.

C. Tagging.

As in previous years tagging in 1953 was carried out mostly from commercial fishing vessels. Most of the liberations were with the Scottish one-man toggle tag, but some liberations were also made with a new one-man bridle attachment, and Lea tags with the toggle attachment were used in the experiments off the Scottish west coast.

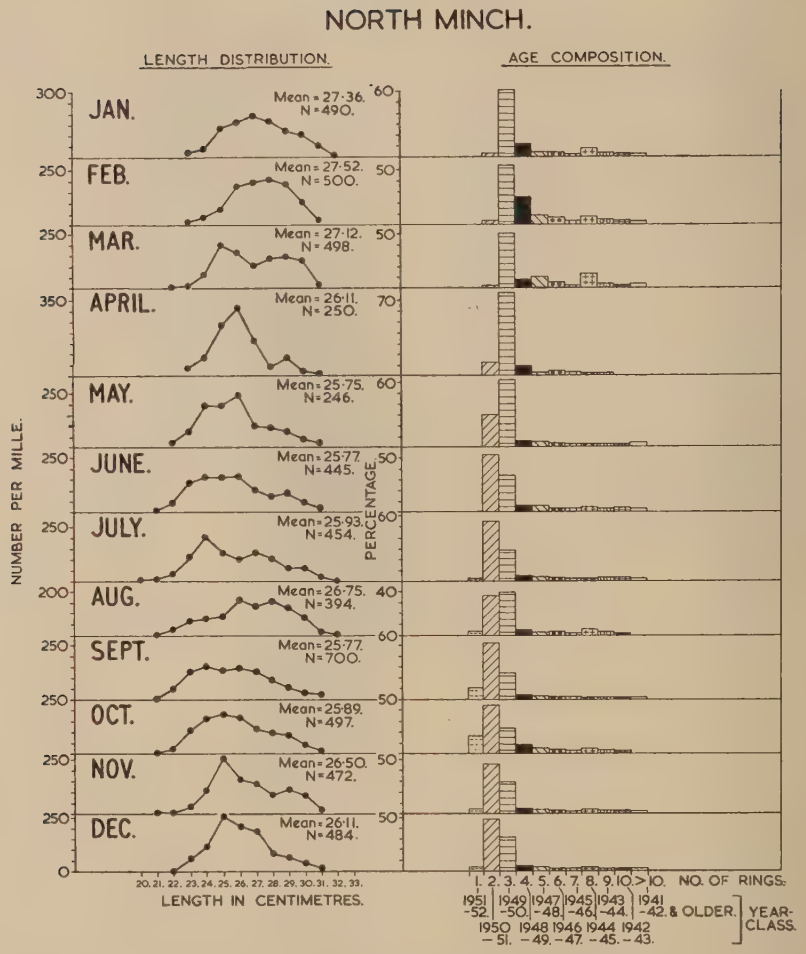


Figure 16. Length and age compositions of North Minch drift-net herring samples. January-December 1953. (Length frequencies unsmoothed).

A total of 12,033 herring were tagged during the year, 10,893 with the Scottish tag and 1,140 with the Lea tag. The main centres of liberation were as follows:—

	1953	Liberations	Tags
Upper Moray Firth	December	476	140 Lea 336 Scottish
North-eastern North Sea (Coral Bank and Patch)	April and May	600	all Scottish
Scottish north-east coast	May-August	6811	»
Shetland	May-July	988	»
North Minch	July-August	3158	1000 Lea 2158 Scottish

The recaptures up to the end of March 1954, totalled 113. Details of the recaptures from

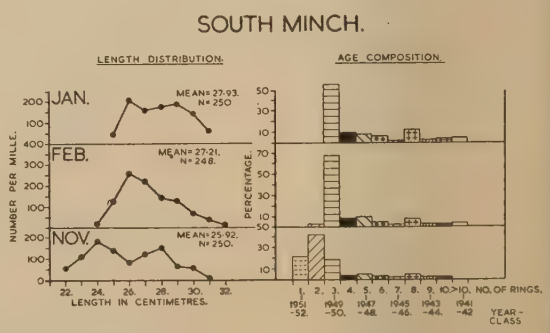


Figure 17. Length and age compositions of South Minch drift-net and ring-net herring samples. January-February and November 1953. (Length frequencies unsmoothed).

Table 16. Maturity and Racial Characters. North and South Minch.

A. Percentage Maturity (all Age-Groups).

Maturity Stage	North Minch												South Minch		
	Jn.	F.	M.	Ap.	M.	J.	Jy.	Au.	S.	O.	N.	D.	Jn.	F.	N.
I.....	18.16	5.20	5.02	12.40	12.20	13.71	14.76	19.29	**33.29**	**23.74**	9.11	14.88	5.20	3.63	**47.20**
II.....	9.59	9.00	**28.11**	18.40	**44.72**	**69.21**	**52.20**	15.99	12.43	16.90	**23.94**	11.57	10.80	11.69	5.20
III.....	16.94	9.20	0.40	—	—	3.37	16.96	13.71	8.71	3.82	3.18	2.07	9.60	9.68	4.00
IV.....	12.24	19.80	0.80	—	—	1.57	6.83	19.54	8.14	1.61	2.54	1.45	10.40	4.03	0.40
V.....	3.06	18.60	—	—	—	—	8.37	17.01	4.29	1.01	0.64	1.45	0.80	0.40	—
VI.....	—	1.80	1.00	0.80	—	—	—	0.51	0.43	—	—	0.21	—	0.40	—
VII & VII-II...	**40.00**	**36.40**	**64.66**	**68.40**	**43.1**	12.13	0.88	13.96	**32.71**	**52.92**	**60.59**	**68.39**	**63.20**	**70.16**	**43.20**
No.....	490	500	498	250	246	445	454	394	700	497	472	484	250	248	250

B. Mean Vert. S. for each Maturity Stage (all Age-Groups)

(Nos. in brackets are No. of fish)

I.....	56.60	56.73	56.54	56.74	56.52	56.68	56.73	56.79	56.74	56.77	56.60	56.58	56.77	56.78	56.74
	(84)	(26)	(24)	(31)	(29)	(60)	(66)	(72)	(229)	(116)	(42)	(69)	(13)	(9)	(117)
II.....	56.63	56.49	56.49	56.48	56.52	56.50	56.62	56.62	56.94	56.48	56.59	56.66	56.81	56.69	56.62
	(46)	(45)	(135)	(46)	(109)	(304)	(229)	(61)	(85)	(84)	(110)	(56)	(27)	(29)	(13)
III.....	56.89	56.91	57.50	—	—	56.60	56.47	56.67	56.66	57.00	56.67	57.11	56.88	56.96	56.80
	(82)	(44)	(2)			(15)	(76)	(54)	(61)	(19)	(15)	(9)	(24)	(24)	(10)
IV.....	57.00	56.93	56.75	—	—	56.86	56.50	56.51	56.51	56.88	56.67	57.14	57.08	56.89	55.00
	(59)	(96)	(4)			(7)	(30)	(74)	(55)	(8)	(12)	(7)	(26)	(9)	(1)
V.....	56.87	56.86	—	—	—	—	56.21	56.36	56.23	56.40	56.33	57.00	57.50	56.00	—
	(15)	(93)					(38)	(64)	(30)	(5)	(3)	(7)	(2)	(1)	
VI.....	—	56.78	57.20	57.00	—	—	—	56.00	56.67	—	—	57.00	—	57.00	—
		(9)	(5)	(2)				(1)	(3)			(1)		(1)	
VII & VII-II ...	56.46	56.40	56.45	56.58	56.67	56.88	57.25	56.50	56.44	56.48	56.56	56.45	56.54	56.46	56.50
	(194)	(175)	(313)	(171)	(106)	(52)	(4)	(52)	(228)	(260)	(282)	(327)	(157)	(172)	(108)
Overall Mean ..	56.65	56.67	56.48	56.59	56.59	56.58	56.57	56.58	56.62	56.58	56.57	56.53	56.68	56.56	56.62

the different tagging centres are summarized below.

Upper Moray Firth. Tagging in this area was undertaken on the "halflin" population in order to trace the subsequent movements of these herring from the nursery area to the offshore grounds in 1954. The offshore fishery has not yet commenced, but 9 recoveries, all from the tagging area, have been recorded to date.

North-eastern North Sea. 9 recaptures have been recorded from the herring tagged in this area in 1953. The positions and times of recapture were as follows:—

Position	Date	Number
North-east coast	6.8.53	1
Fladen.....	27.7.53	1
Dogger Bank.....	16.9.53—22.10.53	5
No date given.....		2
	Total:	9
	Percentage:	1.5

North-east coast and Shetland. The recaptures so far obtained from the 1953 liberations on the Scottish north-east coast and Shetland drift-net grounds are tabulated below:—

North-east coast liberations

Area of recapture	No. of recaptures	Days free
On NE. coast grounds	12	0—81
Fladen.....	35	4—107
Gut.....	1	5
Off NE. coast of England....	4	16—98
Dogger.....	5	37—157
Eastern Channel.....	1	131
Skagerak.....	1	202
Unknown.....	8	
Total:	67	
Percentage:	1.0	

Shetland liberations

Area of recapture	No. of recaptures	Days free
On Shetland grounds.....	1	1
Fladen.....	15	16—135
Dogger.....	1	139
Skagerak.....	2	244—252
Total:	19	
Percentage:	1.9	

North Minch. The following recaptures have been recorded from the North Minch experiments:—

Area of recapture	No. of recaptures		Days free	
	Lea tag	Scottish tag	Lea tag	Scottish tag
North Minch....	1	4	4	3—79
South Minch....	—	2	—	138—193
Unknown.....	1	1	—	—
Total:.....	2	7		
Percentage:.	0.2	0.3		

Further returns from 1952 liberations:—three herring tagged in 1952 were recaptured during 1953 after being at liberty for more than a year. One herring tagged off Fraserburgh on 17. May 1952, was recaptured by drift-net off Shetland on 20. June 1953, and another tagged in the same area on 6. June 1952, was caught by a German trawler on the Fladen Ground on 14. August 1953. The third herring was recaptured in the South Minch on 23. August 1953, at a position only 20 miles from the point of liberation on 3. July 1952.

B. B. Parrish, G. McPherson,
I. G. Baxter, J. D. Buchan.

North Shields Fishery, 1947—53.

Every year since 1947, scale samples have been taken from the fish in the North Shields drift-net fishery. The usual racial characters of vertebral number and maturity stage were also recorded. The period over which sampling took place is shown in Table 17, where the total number of readable scales and the total catch during the sampling period is also shown. During 1947 the sampling was confined to two periods, the first being May when five samples were taken spread over the month. The second period consisted of four samples taken at the end of June and in the first week in July. In 1948 only seven samples were taken, these during the period indicated in the table. The number of crans landed has not been shown for these two years on account of the discontinuous sampling for age data.

Table 17.

Year	No. of readable scales taken	Period of sampling (week ending)	Crans landed in period of sampling
1947	1,579	May and July	—
1948	965	April/May	—
1949	2,495	7. May—23. July	11,462
1950	1,718	9. May—14. August	17,553
1951	1,674	19. May— 4. August	20,797
1952	3,212	10. May—16. August	36,064
1953	3,480	16. May—22. August	31,982

It should be pointed out that the periods of sampling do not cover the whole of the fishery. This continues in most years until the end of September when the fleet moves to the East Anglian area for the autumn fishery. The starting dates of the sampling, however, give a reasonable indication of the beginning of the landings by the drifters.

Hodgson has described the fishery and the changes in the stock during the period 1923—1928. He distinguished three phases. Firstly, the catches were characterized in April and May by a very high percentage of herrings which were recovering spents. A little later there appeared younger herring whose gonads were in stage I of the Hjort Maturity System, that is, they were immature. These usually reached a maximum in July or August. In July "full" fish began to occur and the proportion of these increased throughout the month and into August and September when a few spawning fish were taken. Throughout this period the main age-group was IV.

In Figure 18, the percentage number of stages I, II, II/III, VII and VII/II have been

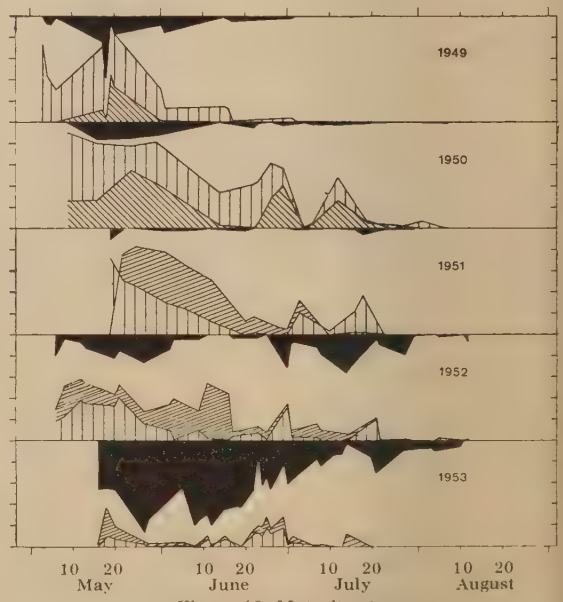


Figure 18. Maturity stages.

I. Immature.
VII and VII/II. Recent spents.
II. Recovering spents.
II/III. Maturing spents.
III. Maturing fish.

plotted for each sample taken in the years 1949—1952. The stages VII/II and II/III have been used to describe gonads whose condition does not fit them completely into either conventional stages. In reality the stage VII/II will contain fish of stage VII and stage II and similarly stage II/III contains fish of stages II and III. Bearing this in mind it can be seen that in 1949 and 1950 there were present in the shoals recently spent fish as indicated by the VII and VII/II. In 1951 a few of these are seen in July but the general stage of maturity is higher. 1952 and 1953 are characterized by the increasing numbers of immature fish in the shoals and also the slightly higher maturity of the spents as indicated by the stage II/III. 1953 is remarkable for the abundance of immature fish in the shoals.

This high proportion of stage I fish in 1953 is reflected in the age composition as can be seen in Figure 19. 80 % of all fish landed during the sampling period belonged to age-group III, i.e., fish having two winter-rings and three summer zones. They are fish maturing for the first time. Corresponding with the appearance of this extremely strong year-class the mean length of the fish as sampled, is seen to be more than 1 cm. less than in the previous two years.

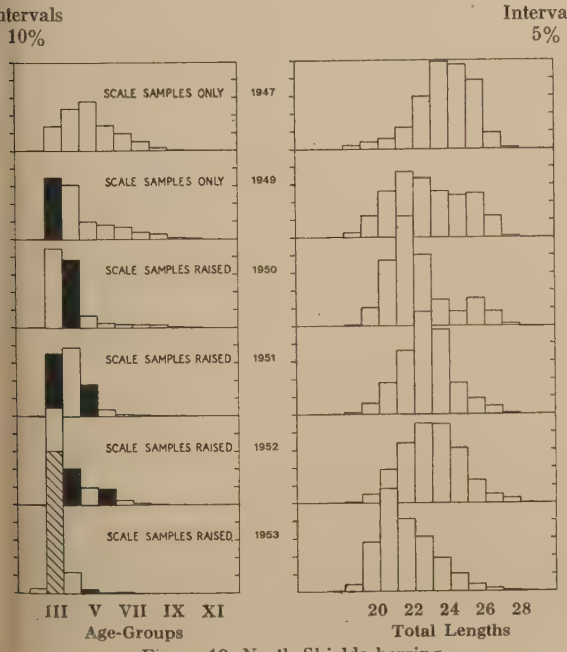


Figure 19. North Shields herring.

Table 18. % Age Distribution.

Age-group / Year	II	III	IV	V	VI	VII	VIII	IX	X	X+
1947[1])	0.4	14.2	24.0	28.0	14.7	10.2	5.5	1.9	0.6	0.5
1949[1])	0.2	34.8	31.3	10.0	8.4	6.9	4.1	2.8	1.0	0.5
1950	0.4	44.9	38.6	6.8	2.6	2.3	2.1	1.6	0.6	0.1
1951	0.3	35.6	38.9	18.3	3.7	1.3	0.8	0.5	0.5	0.1
1952	0.4	54.9	20.7	10.2	9.2	2.7	1.1	0.5	0.2	0.1
1953	2.9	80.4	12.3	2.4	0.7	0.9	0.3	0.0	0.1	0.0

[1]) Scaled samples only.

The age distributions, Table 18, from 1950 to 1953 represent the percentage age composition of the stock as landed—the laboratory samples being raised to the total catch during the sampling period. This has not been done for 1949 or 1947. In both these years the sampling was grouped over short periods. The grouping of the samples in 1949 is apparent from Figure 18.

The length distributions which form the second part of Figure 19 are those of the laboratory samples and have not been "raised" as were the age compositions for 1950—1953. It is interesting to compare the lengths of the main centimetre-groups in each year with the corresponding age composition. As was noted previously in 1953 when 80 % of the stock are age-group III, the commonest length group is 22 cm. In 1952 and 1951 the 24- and 25-cm. groups are almost equally important and the percentages of age-group III are 54 % and 36 % respectively. The 23-cm. group is the most important in 1950 and 1949 when the percentages of age-group III are 45 % and 35 % respectively. Thus the marked difference in the 1952 and 1951 length distributions from the others is most apparent, as is the similarity between 1949, 1950 and 1953.

The North Shields ground being a feeding area, is, by its very nature, subject to great changes in the stock of herring on the grounds. Within a short period the age composition of the shoals may alter from all young fish to mixed ages and back to young fish again. In addition, in the older age-groups where scale pattern is beginning to be apparent, one can distinguish fish having different types of growth patterns on the scales, giving a further indication of the extreme mixing which takes place.

The mean lengths of age-group III have been plotted in Figure 20. They are seen to vary considerably. The mean lengths for 1951 and 1952 are seen to be high, as were the mean lengths for all age-groups.

During these two years there was a remarkable invasion of exotic five- and six-year-old fish. This was most marked in 1952, when the samples of fish taken on 25. and 30. June contained 34 % and 38 % six-year-olds respectively. The mean vertebral number and mean length of these fish were much lower than those of the same year brood in the six samples before and after their appearance. The five-year-old fish also showed similar characteristics. An additional feature was the lowness of the fat content of these fish compared with the other samples. The details of mean lengths and mean vertebral numbers appear below. The mean lengths of the five-year-olds before and after the invasion by these unusual fish are given for comparison in parenthesis. Means which are significantly different are given in heavy type—those in italics are almost significantly different.

Year	Age-group	Mean Vert. S.	S.	Mean length	S.	Number
1952	VI	**55.34**	0.79	**25.34**	0.84	82
		(56.40)	(0.88)	(26.84)	(1.09)	(73)
1951	VI	55.09		25.68		11
1952	V	*55.81*	1.01	25.98	1.09	31
		(56.55)	(0.68)	(26.21)	(0.93)	(105)
1951	V	*55.67*	1.22	25.53	0.97	36
		(56.33)	(0.58)	(25.91)	(0.83)	(36)

The dates of the appearance of these fish in the samples were for both the V- and VI-groups: 23., 25., 30. June and 1. July 1952, and 3. July 1951.

In 1950, in the sample of 4. July, there were small numbers of fish having low vertebral numbers; a few IV-group were present in addition to the V- and VI-groups. Unfortunately, vertebrae were not counted in the other samples at this time and no estimate of the abundance of these exotic fish can be made. These fish did not make an appearance in the shoals in 1953, but on 5. June a sample of fish having a mean vertebral number of 55.96 was taken. Throughout the rest of the month the samples showed relatively higher numbers of fish with 54 and 55 vertebrae than normal. The majority of the fish were age-group III. It would appear, therefore, that there is now a fairly regular immigration into the Northumberland coast area of fish with low vertebral numbers in June and July, and this seems to be a post-war phenomenon.

Figure 20. Mean lengths of age-group III.

A. C. Burd.

Reference.

Hodgson, W. C. 1925, 1929. "Investigations into Age, Length and Maturity of the Herring of the Southern North Sea". Part II: Fish. Invest., Ser. II, **8**, 5; Part III: **9**, 7.

Strange Herring on the East Anglian Coast.

During February 1954, inshore boats fishing for sprats with the Larsen trawl in the Thames out of Southend and Wivenhoe encountered varying numbers of herrings in their catches. Beginning on 22. February, a proportion of herrings caught were of marketable value. The size range of the fish as caught was between 13 and 26 cm. On being landed they were sorted into two groups: those ranging between 13—18 cm. long being sold for fish meal and those over 18 cm. for table use.

Between 23. February and 10. March four samples, comprising two "as caught", and two "as sent to market" (720 fish) were examined at Lowestoft. These four samples have been treated collectively, all data being translated to percentage form.

For purposes of comparison among the samples available, two were taken. These were both of longshore fish, one from Kessingland and the other from Winterton, both dating from March 1953. On examination, (see Table 19 below) by taking the principal age-groups, i.e., three and four in each, it is readily seen that these are samples of the same or closely related stocks. The discrepancy between the mean lengths for the whole samples, Kessingland 24.89 cm., Winterton 26.49 cm., can be accounted for in there being a higher percentage of older fish in the latter. The two samples share a predominance of fish having maturity stage II, Kessingland 69 %, Winterton 73 %. The mean vertebral count differs

by 0.18 and that of the three- and four-year-old fish in each shows no significant difference. These two samples were taken collectively and compared with those from the Thames.

Table 19.

March, 1953 Sample	Vertebrae 3-yr.-olds	Vertebrae 4-yr.-olds	Vertebrae Whole sample	Length 3-yr.-olds	Length 4-yr.-olds	Length Whole sample
Kessingland	56.15	56.55	56.30	24.09	26.13	24.89
Winterton .	56.33	56.25	56.48	24.39	26.56	26.49
W. & K....	56.18	56.44	56.36	24.17	26.40	25.63
Thames ...	54.84	54.88	54.73	21.37	22.43	20.79

It will readily be seen that there is considerable difference between these fish. In the three- and four-year-old fish there is a size discrepancy of almost 3 and 4 cm., that for the total samples being almost 5 cm. The Thames fish show a lower vertebral count, 54.73 as against 56.36 (whole sample) in the East Anglian fish. The maturity stages for the former are mainly I and IV—V, while the latter are principally II.

The low vertebral count of the Thames fish is most noticeable. It is significant that Mr. R. J. Wood, working on 0-group herring from Sutton-on-Sea and Lowestoft in September and October 1953, found a similar low mean vertebral count.

G. C. Bolster.

Herring from the "Otterbank".

During recent years a small fleet of German trawlers has been fishing for herring in March on the "Otterbank" (60°05′N., 3°32′E.).

Three samples of herring were taken from the landings in 1953. The length composition is presented in Figure 21 a. The average length was 34.69 cm., the average weight was 311.01 g.

The "Otterbank" is a spawning area for these herrings as shown in Figure 21 b indicating the maturity of the herring. At the beginning of March many herring were just spent (53.5 %) or spawning (37.5 %).

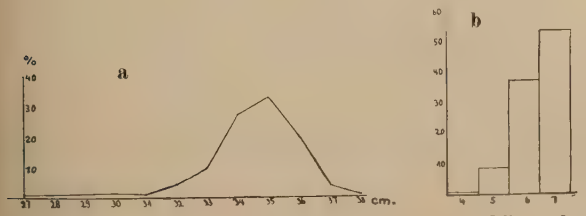


Figure 21 a. Length composition (%) of "Otterbank" trawl herring samples.
b. Maturity stages (%).

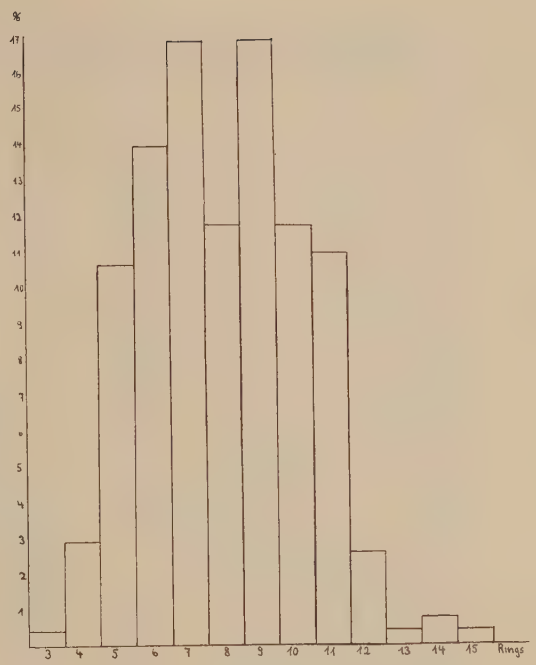


Figure 22. Age composition (%) of "Otterbank" herring.

The scales of these fish showed a range of 3 to 15 rings (Figure 22). The bulk of the fish consisted of herring with 5 to 11 rings on their scales. At the beginning of March the stock consisted of older herring having 9 to 11 rings, and at the end of the month the younger year-classes of 5—7 rings predominated.

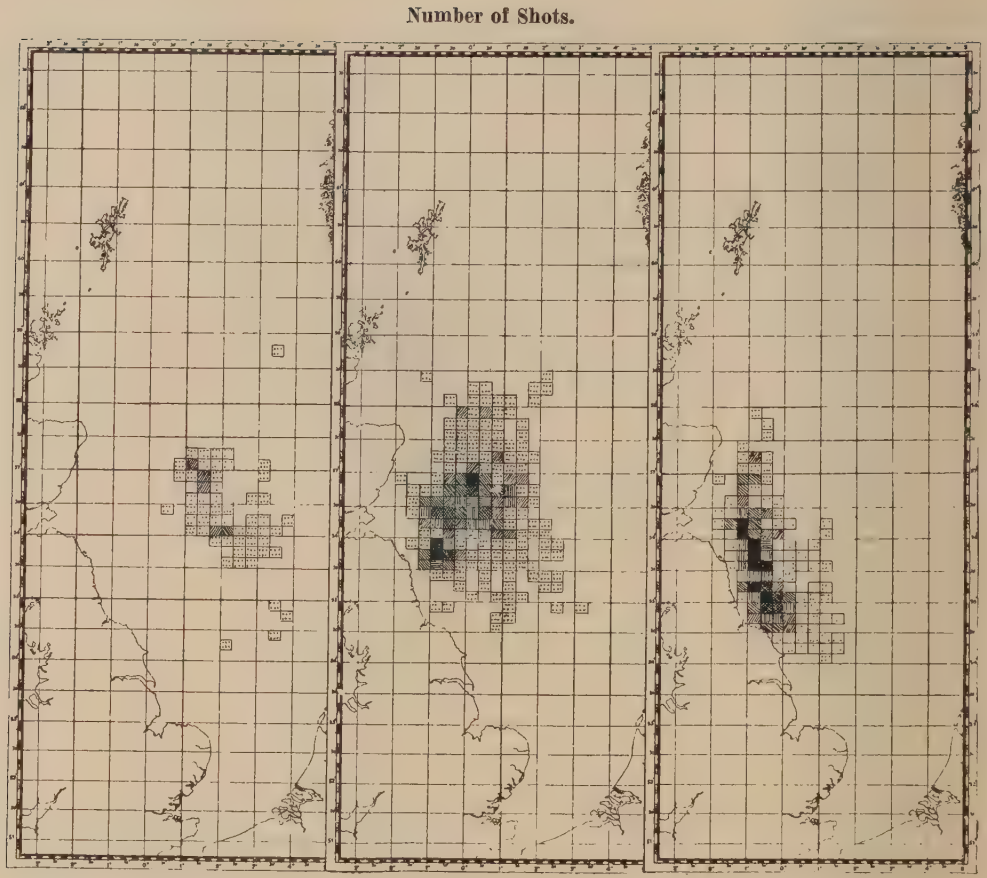
The meristic charateristics of the herring (average for all samples V. S. 57.6 and K_2 13.7) agree with those of the spring spawners from the Atlanto-Scandinavian region.

K. Schubert.

The Dutch Herring Fisheries in 1953.

Drift-net fisheries.

A still somewhat greater number of vessels than last year gave information about the area and the quantity of the catches. The Charts 1—24 show the results. The number of nets rose from 50 at the start of the season via 65 and 80 in June to 100 in the course of July and remained 100 in the other months. The nets were set either for surface or for deeper water fishing.



Charts 1—3. May June July

This year the concentration of the fleet has in general been more towards the British coast than in 1952. This was especially the case in the months June, July and August. The charts show that the ships concentrated in the areas of the biggest catches.

In September the catches in the Dogger Bank area were well below those of 1952.

The East Anglian fishery gave lower catches in October and higher ones in November and December than in the same months of the previous year.

The charts of the maturity stages (Charts 17—24) give the same general impression as in 1952. The catches in the East Anglian fishery consisted of more full and less spent herring.

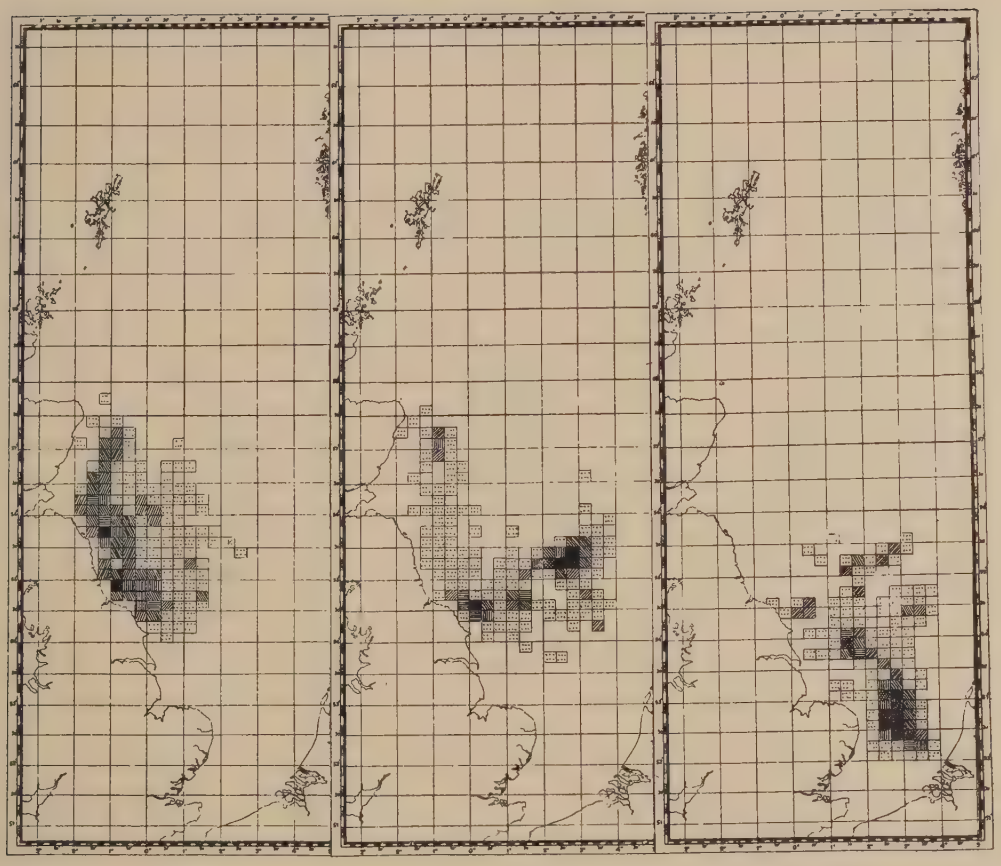
Table 20A gives the total quantity of drift-net herring landed. Up to now it has been assumed that one "kantje" comprised 94 kg. of herring. It has this year been shown that the average weight of one "kantje" "maatjes"-herring is 94 kg. and of one "kantje" full, spent and ungutted herring 90 kg.

The landings of ungutted and fresh herring in the months January-May have not been comprised in the charts. These herring were caught in the English Channel, Irish Sea, Silver Pit (March) and northern North Sea (April-May).

The total weight of herring landed by the drift-net fisheries was 106,952 tons.

J. DE VEEN.

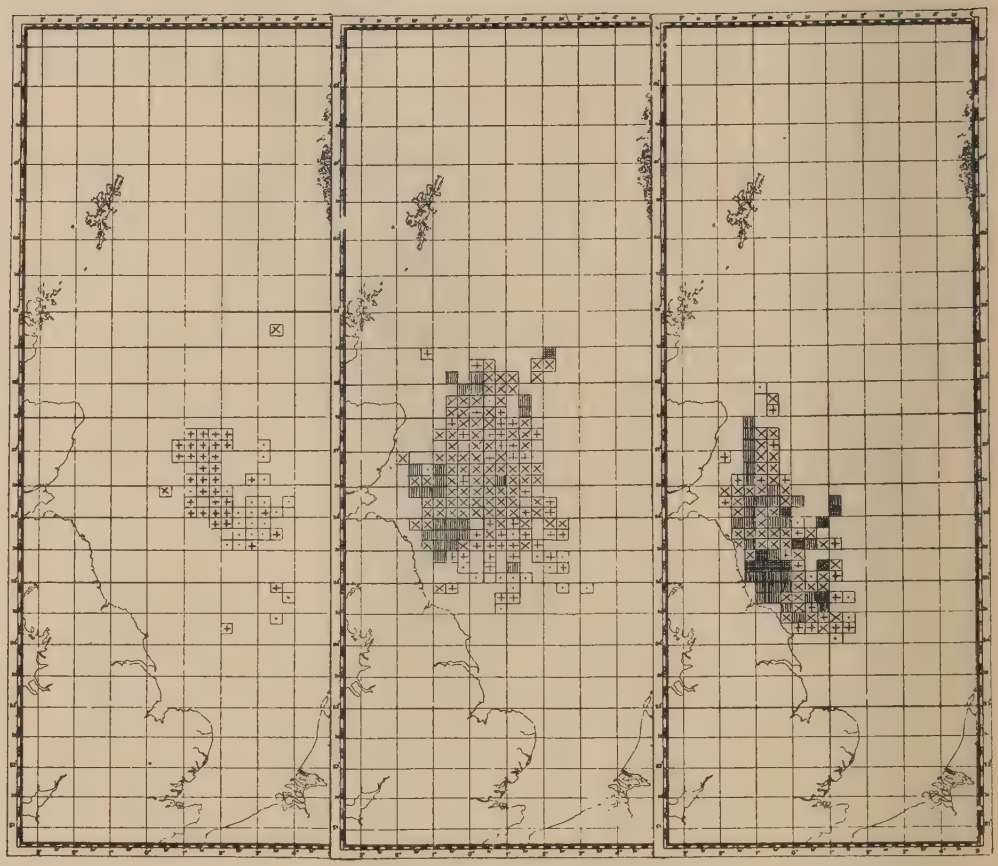
Number of Shots.



Charts 4—6. August September October

Charts 7—8. November December

Mean Catch per Shot (in Kantjes).

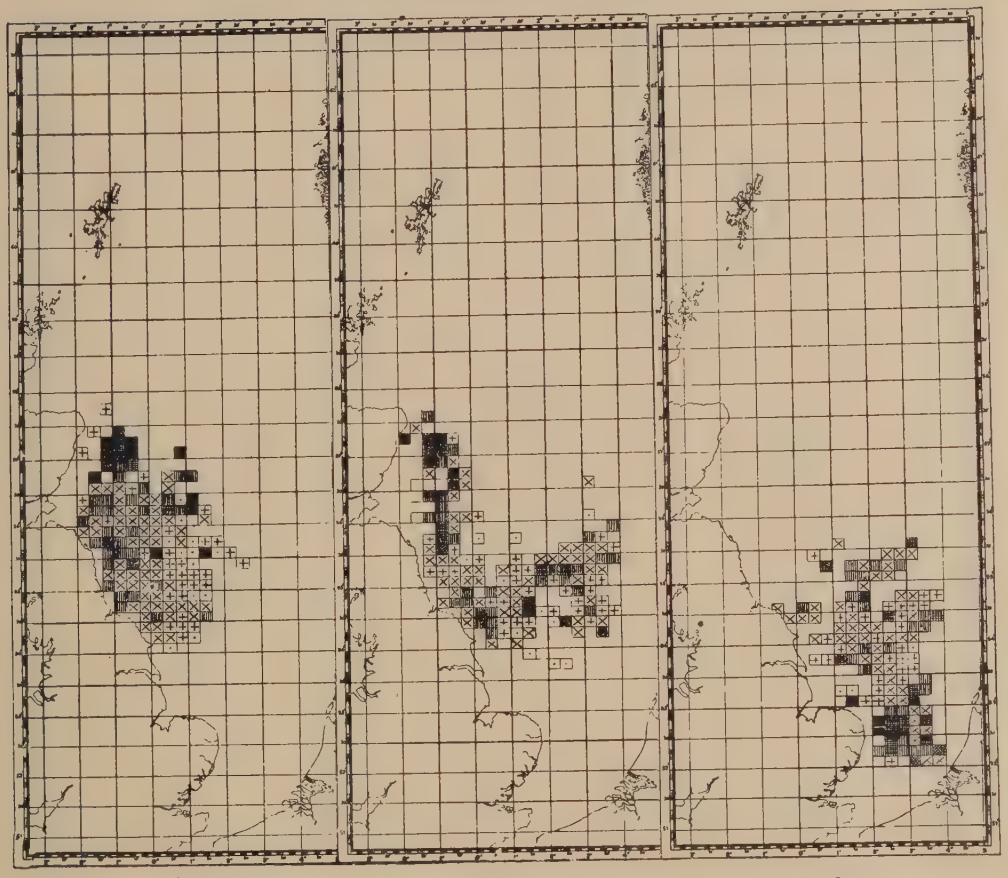


Charts 9—11. May June July

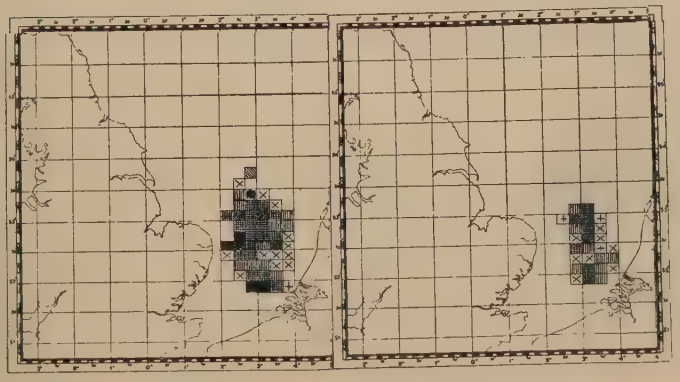
Table 20. Quantities of Herring landed in Dutch Ports in 1953.

Month	A. Landed by the Luggers fishing with Drift-Nets. Salted herring (in kantjes) Matjes	Gutted Full	Spent	Ungutted	Fresh herring (in kg.)	B. Trawled Herring (in tons). Trawlers	All kinds of vessels
January	—	—	2	4,184	517,425	29	407
February	—	—	—	1,681	1,000,825	304	437
March	—	—	—	64	843,375	876	2,862
April	—	—	62	892	1,428,150	155	372
May	1,106	—	—	—	613,750	157	221
June	81,792	—	—	2,055	167,483	80	89
July	125,624	68	—	5,910	393,448	1,638	2,290
August	64,335	11,137	4,010	7,693	35,940	4,661	11,612
September	8,734	36,116	7,160	20,667	13,000	5,845	14,368
October	1,979	46,929	4,322	112,635	439,125	6,792	11,956
November	—	8,455	184	255,708	1,529,044	3,034	3,566
December	—	1,897	562	155,790	2,477,970	4,369	5,729
Total 1953	283,570	104,602	16,302	567,279	9,459,535	27,940	53,909

Mean Catch per Shot (in Kantjes).

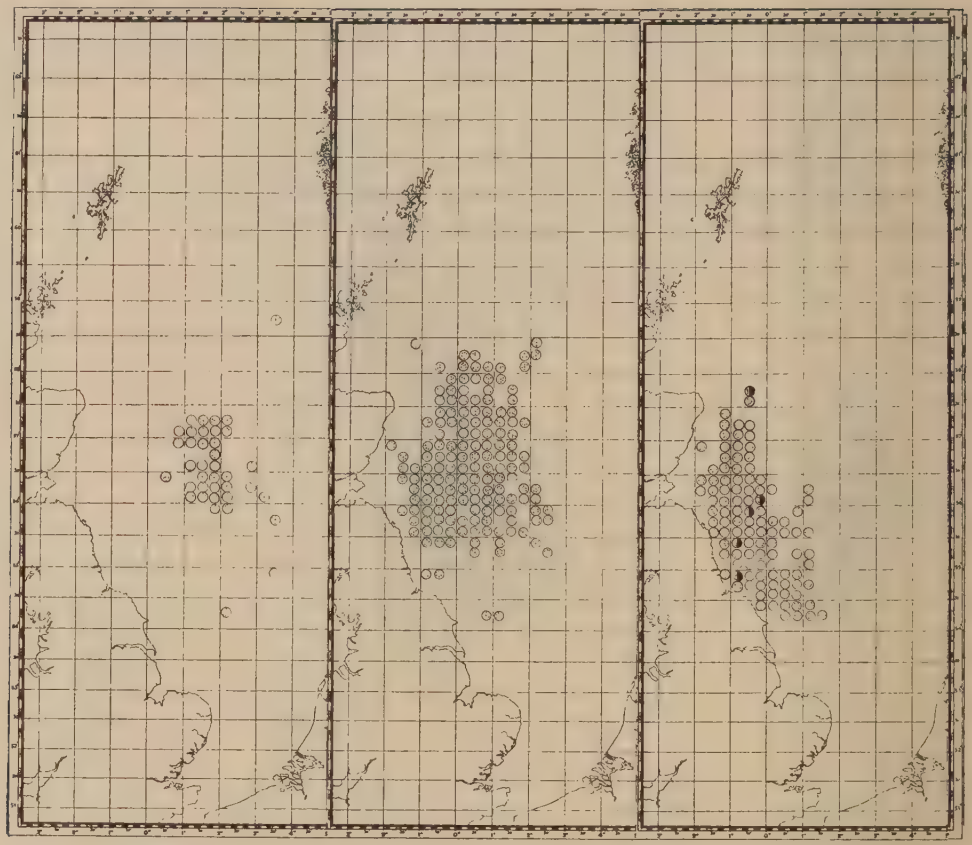


Charts 12—14. August September October



Charts 15—16. November December

Sorting.



Charts 17—19. May June July

Sorting.

Matjes

Matjes and Full

Matjes, Full and Spent

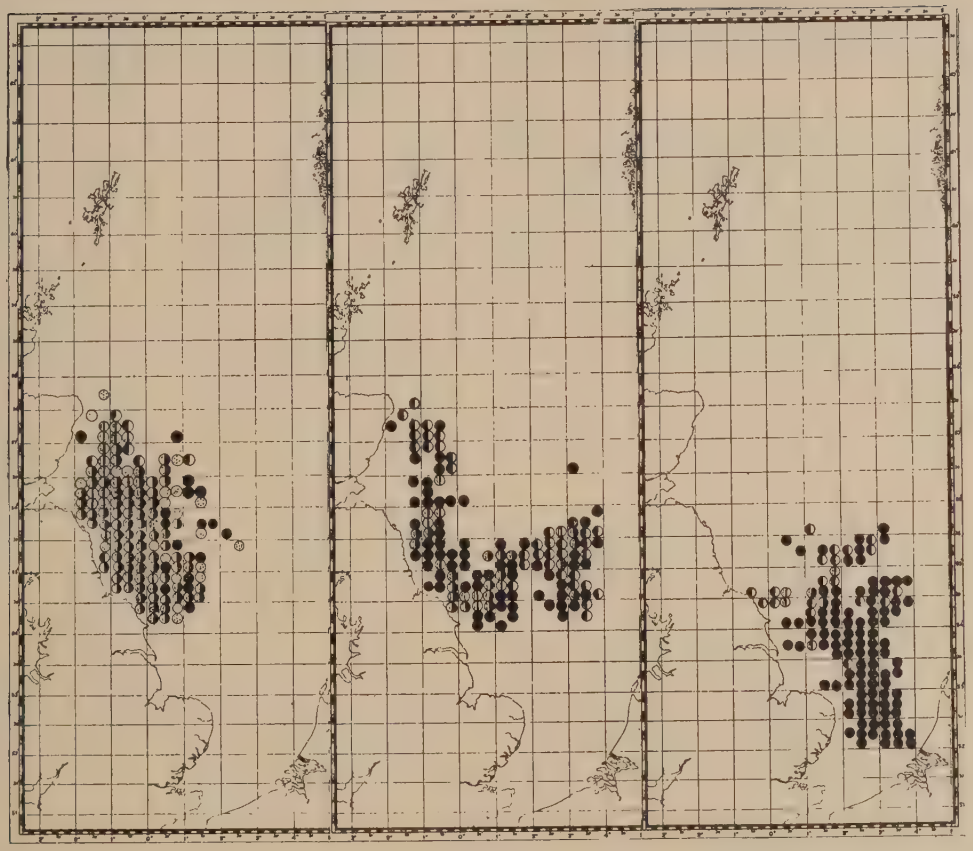
Full and Spent

Full

Spent

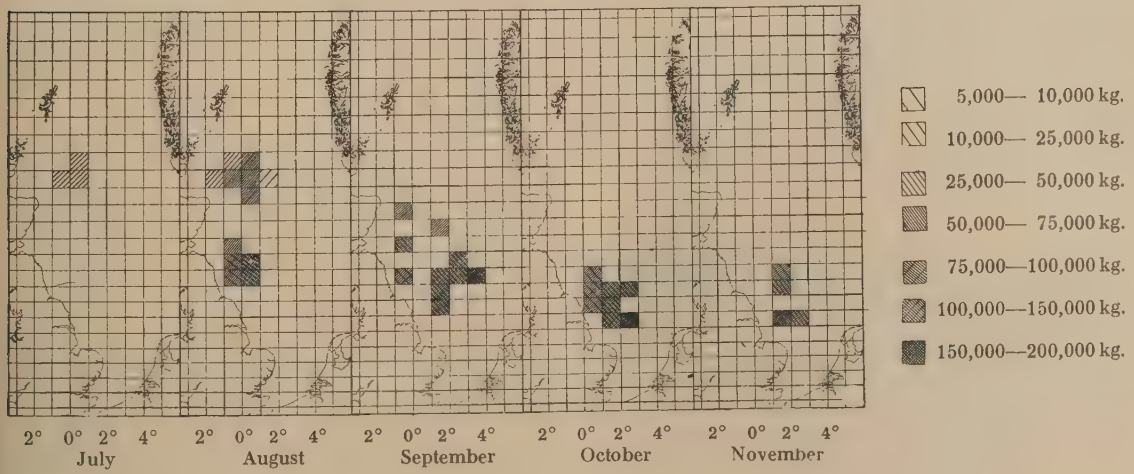
Charts 23—24. November December

Sorting.



Charts 20—22 August September October

Dutch Catches of Trawled Herring per 100 Hours Fishing.



Charts 25—28.

Trawl fisheries.

The catches of herring per 100 hours fishing by the Dutch steam trawlers fishing with the herring trawl are shown in the Charts 25—29.

The catches in the Fladen area (July, August) were below those of 1952. The area south of 56°N. gave in all months (August—November) higher catches than the year before.

Table 20 B gives the quantity of herring landed by the trawlers and by the whole fleet fishing with trawl-nets. The landings of the trawlers were in July below and in August—November above those of 1952.

The total quantity landed was considerably above that in 1952.

L. K. Boerema.

Full-Herring Concentrations exploited by the Belgian Herring Trawlers in 1953.

1. Activity–Landings.

The fishery started around mid-July and was carried out on the usual grounds. During November, the best catches were made around the lightships "Ruytingen", "Sandettié", and "Dyck", where the catches consisted mainly of full and ripe herring.

In the northern and central areas of the North Sea, the fishery was exclusively carried out with the otter-trawl, whereas in the southern area 96.58 % of the catches were obtained by the use of the pelagic trawl, towed by two trawlers fishing together. The results gained by each method are given separately.

The total landings of the campaign amounted to 10,514 tons of fish or 9,899 tons herring (94.16 %). The otter-trawl gave 7,434 tons herring (75.09 %), the pelagic trawl 2,466 tons (24.91 %).

2. Fishery.

Tables 21—23 give records of fishing effort and the yield of the fishery, as regards vessels operating with otter-trawl. 23 trawlers participated in the fishery and made 130 trips during the season (Table 21). The catches were mainly composed of herring (Table 22), the yield of which totalled 7,433 tons (Table 23) or 96.9 %, as against 6,529 tons in the previous season. The catch per trip (57 tons) was nearly

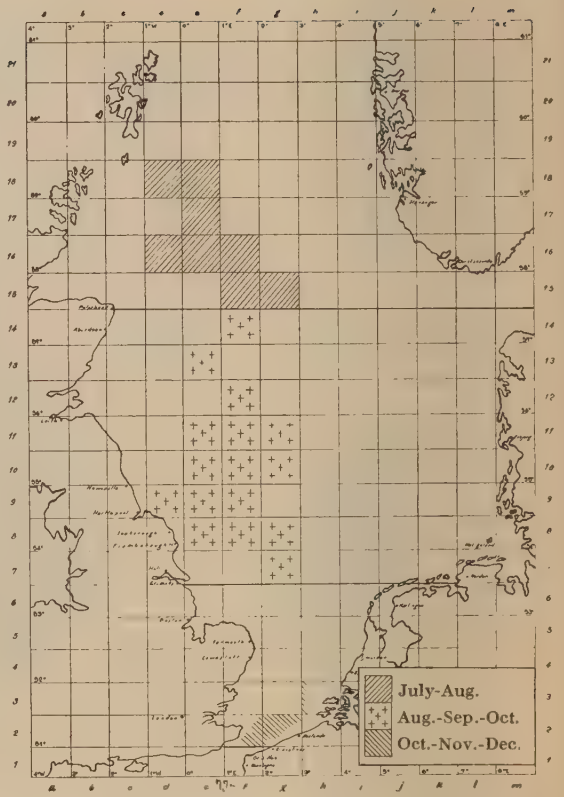


Figure 23. Fishing grounds exploited by Belgian herring trawlers in 1953.

160 % higher than in the previous year (22 tons).

Table 24 shows the number of trips, total catch and yield per trip from the pelagic fishery. It appears that the yield per-unit-of-effort (catch per trip) is only a fraction of that from the otter-trawlers.

3. The herring stock.

The material investigated consisted of 20 samples comprising 1537 fish covering the northern (290), central (1045) and the southern (202) area. It was collected in Aug. (440), Sept. (476), Oct. (419) and Nov. (202).

Table 25 shows the size distribution of the herring by areas and from month to month during the season. The average weight and the percentage number of males are also recorded. The average size of the fish (269 mm.) was practically the same as in 1952 (268), whereas the weight (175 g.) was a little bit higher (170).

Table 21. Number of Trips with Otter-Trawl and Capacity of the Fishing Fleet.

Months.	Number of trips				Tonnage (1000)			
	North.	Centr.	South.	Total	North.	Centr.	South.	Total
July	8	—	—	8	714	—	—	714
August ..	23	7	—	30	1555	275	—	1830
Sept.....	—	41	—	41	—	1817	—	1817
Oct.....	—	38	1	39	—	1783	16	1799
Nov.....	—	—	7	7	—	—	121	121
Dec.....	—	—	5	5	—	—	164	164
Total 1953	31	86	13	130	2269	3875	301	6445
Total 1952	—	—	—	296	—	—	—	6280

Table 22. The Total Yields by Otter-Trawl Vessels.

Species		Tons	‰
Pelagic	Herring.....	7433	924
»	Sprat.....	5	1
»	Mackerel.....	350	43
»	Others.....	7	1
Demersal	Haddock.....	25	3
»	Cod.....	60	8
»	Saithe.....	42	5
»	Whiting.....	74	9
»	Others.....	46	6
Total Pelagic Spec.....		7795	969
» Demers. »		247	31
Grand Total.....		8042	1000

Table 23. The Yields of Herring (Otter-Trawl).

Month	Total catch (1000 tons)				Catch per trip (tons)			
	North.	Centr.	South.	Total	North.	Centr.	South.	Total
July	334	—	—	334	42	—	—	42
Aug.	1304	360	—	1664	57	51	—	55
Sept.	—	2448	—	2448	—	60	—	60
Oct.	—	2436	37	2473	—	64	37	63
Nov.	—	—	167	167	—	—	24	24
Dec.	—	—	347	347	—	—	69	69
Total 1953	1638	5244	551	7433	52	61	42	57
Total 1952	—	—	—	6529	—	—	—	22

Table 24. Fishing Effort and Yield of the Fishery with Pelagic Trawl.

Month	No. of trips	Total catch (1000 tons)	Av. catch per trip (tons)
October.....	6	24	4.0
November.....	357	2418	6.8
December.....	4	24	5.9
Total.....	367	2466	Mean 6.7

As to maturity it is evident from Table 26 that stage V was largely predominating in all areas and through all months. It is interesting to note for comparison that in 1952, this stage dominated only on the northern fishing grounds and that stage VI was then predominant in the central area.

Table 25. Size, Weight etc. (‰).

Cm.	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
31	21	2	—	5	14	2	2	—
30	83	27	—	34	57	46	12	—
29	**255**	104	39	124	**191**	101	122	39
28	159	**184**	139	173	168	**175**	193	139
27	200	179	**257**	**193**	186	168	**198**	**257**
26	90	165	213	157	132	130	189	213
25	96	132	134	126	132	111	131	134
24	52	116	129	106	68	122	115	129
23	38	67	69	62	46	103	29	69
22	3	21	15	17	4	38	7	15
21	3	3	5	3	2	4	2	5
Total	1000	1000	1000	1000	1000	1000	1000	1000
Aver. length, mm.	278	267	264	269	—	—	—	—
Mode, cm.	29	28	27	27	—	—	—	—
Weight, g.	208	170	156	175	—	—	—	—
Males (%)	43	48	67	50	—	—	—	—

Table 26. Stages of Maturity (‰).

Stages	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
I.....	21	13	5	14	16	19	10	5
II....	17	25	10	21	18	31	19	10
III...	65	42	—	41	134	8	—	—
IV...	314	119	—	140	341	132	5	—
V....	**459**	**500**	**450**	**486**	**407**	**603**	**453**	**450**
VI...	10	211	292	184	9	74	439	292
VII..	7	14	208	38	4	13	21	208
VIII-II	107	76	35	76	71	120	53	35
Total.	1000	1000	1000	1000	1000	1000	1000	1000

Table 27. Quantity of Intestinal Fat (‰).

Quantity	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
0	172	313	**623**	327	173	237	449	**623**
1	**372**	**420**	357	**403**	291	**466**	**470**	357
+	352	213	10	213	**395**	263	62	10
M	104	54	10	57	141	34	19	10
Total	1000	1000	1000	1000	1000	1000	1000	1000

As in earlier investigations the quantity of intestinal fat was estimated. The results are shown in Table 27.

The composition of the catches, as to age, is demonstrated in Table 28. It appears clearly that the 4-year-old fish was predominant all over the fishing grounds and in all months. The sequence of the most important year-classes, as to their relative strength proved to be as follows: 1949 (243 ‰), 1950 (196), 1946 (139), 1948 (127) and 1947 (91).

It is of great interest to compare the age composition of the catches from year to year,

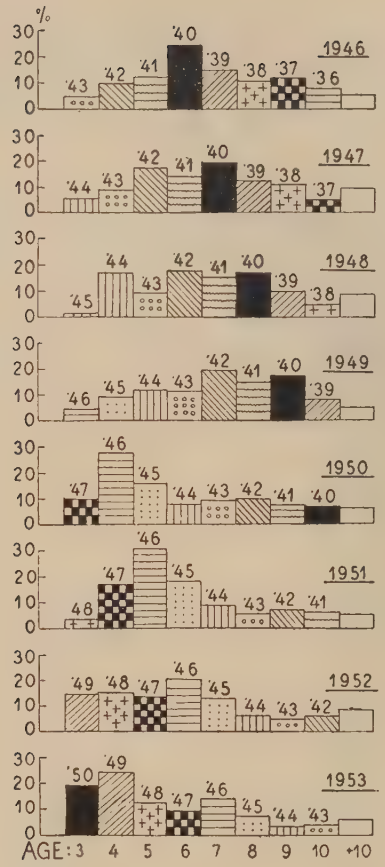


Figure 24. Biological scale of the full-herring concentrations exploited by the Belgian herring trawlers during the years 1946–53.

as is done in Table 29. The table deals with the 8-year period from 1946 to 1953. It is seen that the absolute dominant is found in one of the age-groups IV—VII. It seems that the 1946-brood has been the most successfull one during the period, being an absolute dominant through 3 subsequent years (1950—1952). It is also interesting to note that during recent years (1950—53) the fish has tended to be younger than before, taking the stock as a whole. At the same time there has been a general trend towards increased average length of the whole stock (Table 30). On the other hand the growth-rate during the first year (L_1) does not seem to have changed very much (Table 30).

As to the number of vertebrae (VS) a survey is given in Table 31. The average figure for the whole season was found to be 56.496.

It should be pointed out that compared with the previous years, the average number of vertebrae shows a rather marked decrease. This is to a large extent due to the relative small number of herrings belonging to the first group "spring-spawners" present in the samples of 1953. These herrings have always had a markedly higher vertebral average than those of the second group "autumn-spawners".

This is clearly shown on the following diagram. This diagram shows two curves: the full line representing the annual distribution of the vertebral average and the dotted line the annual distribution of the percentages of the herring belonging to the first group. The two lines follow the same trend, from which it may be deduced that each increase of the vertebral average is accompanied by an increase of the herrings of the first group or vice-versa.

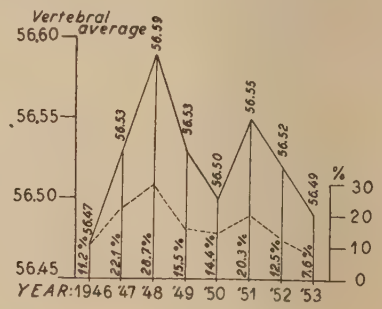


Figure 25.

——— annual vertebral average
- - - - - annual percentage of herrings of the 1st group.

Finally Table 32 gives the number of keeled scales (K_2) by areas and by months. The average number for the whole season was found to be 14.808 and there did not seem to be any pronounced difference from one area to another or from month to month.

Stomach analyses were made on all the herrings investigated. Only 5.2 % were found to contain food, mostly remains of copepods.

4. Forecasts for the full-herring campaign 1954.

In 1952 good fishing was forecast for 1953. As the average catch per fishing hour/100 H. P. developed, which reached 104 kg. during 1952, increased to 115 Kg., we estimate that the 1953 forecasts were completely confirmed.

Table 28. Age (‰).

Age	Year-class	By Areas North.	Centr.	South.	Total	By Months Aug.	Sept.	Oct.	Nov.
2	1951	—	6	—	4	—	4	11	—
3	1950	91	221	230	196	117	318	152	230
4	1949	**210**	**247**	**267**	**243**	**258**	**215**	**238**	**267**
5	1948	124	124	143	127	135	95	141	143
6	1947	120	83	87	91	109	73	89	87
7	1946	139	139	137	139	144	117	156	137
8	1945	57	67	93	69	47	73	78	93
9	1944	91	24	12	35	67	29	15	12
10	1943	72	33	25	39	53	36	34	25
>10<	1943	96	56	6	57	70	40	86	6
	Total	1000	1000	1000	1000	1000	1000	1000	1000

Table 29. Age Composition of the Catches during 1946-53 (‰).

Age	Years 1946[1])	1947	1948	1949	1950	1951	1952	1953	Total
3	45	53	11	45	99	34	146	196	104
4	94	87	167	91	**278**	163	148	**243**	**172**
5	119	172	94	122	158	**305**	135	127	142
6	**241**	137	**176**	114	78	180	**201**	91	144
7	145	**187**	153	**192**	89	90	126	139	142
8	108	119	167	145	96	56	62	69	96
9	115	109	97	165	73	69	45	35	81
10	76	44	45	77	66	56	57	39	56
>10	51	91	87	49	63	47	80	57	62

[1]) + 6 ‰ 2-year-olds.

Table 30. Average Lengths by Age and the Value of L_1 (mm.).

Brood	Lengths North.	Centr.	South.	Mean	L_1 North.	Centr.	South.	Mean
1950	241	242	244	242	114	120	120	119
1949	257	262	262	261	108	114	108	112
1948	274	271	270	272	114	107	100	107
1947	287	276	278	279	120	112	107	114
1946	284	283	279	282	115	118	103	115
1945	287	287	282	286	116	110	101	109
1944	292	287	276	289	124	110	106	117
1943	293	293	288	292	119	104	108	110
Averages	276	268	265	269	115	115	108	114

As already mentioned, the four youngest year-classes (three- to six-year-old herrings) were exceptionally well represented in the catches. This large proportion of young classes points to a promising renewal of the herring stocks. This may be considered to promise good for the results of the 1954 campaign.

However, caution must be expressed. Contrary to the previous years, the pelagic trawl was nearly exclusively used for the full- and spent-herring fisheries in the southern area of the North Sea and by fishermen of several countries. According to the results recorded

Table 31. Number of Vertebrae (VS, ‰).

VS	By Areas North.	Central.	South.	By Groups 1st Group	2nd Group	By Months Aug.	Sept.	Oct.	Nov.
59	11	3	5	0	5	7	6	—	5
58	85	76	56	96	74	84	89	60	56
57	386	404	426	436	401	385	393	424	426
56	**422**	**456**	**462**	**457**	**450**	**440**	**447**	**458**	**462**
55	92	56	41	11	65	82	61	51	41
54	4	5	10	—	5	2	4	7	10
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000
Average	56.489	56.499	56.492	56.617	56.488	56.487	56.521	56.480	56.492

Table 32. Number of Keeled Scales (K_2) in ‰.

K_2	By Areas North.	Centr.	South.	Total	By Months Aug.	Sept.	Oct.	Nov.
19	—	1	—	1	—	—	2	—
18	4	1	—	1	2	2	—	—
17	24	26	15	24	32	17	29	15
16	133	164	169	159	159	148	167	169
15	**479**	**458**	**468**	**463**	**472**	**458**	**457**	**468**
14	311	296	293	299	284	310	304	293
13	45	52	55	51	49	63	39	55
12	4	2	—	2	2	2	2	—
Total	1000	1000	1000	1000	1000	1000	1000	1000
Mean	14.780	14.818	14.796	14.808	14.843	14.746	14.845	14.796

during the last full-herring campaign, it is established that the catching efficiency of this trawl is nearly triple that of the otter-trawl. So much so that for a smaller fishing effort, the full-herring catches in the southern area were nearly double those of 1952. Thus, the question arises, whether the herring stock will be able to support such an intensive fishery indefinitely without showing sign of overfishing, especially at the critical moment of reproduction.

Ch. Gilis.

Spent-Herring Concentrations exploited by the Belgian Herring Trawlers in 1953-54.

1. Fishing effort.

The spent-herring season started earlier than in previous years. It began on the 28. November 1953 and finished the 3. March 1954.

Most of the time, the fishery took place off the Belgian and French coasts and chiefly within an area limited by the lightships "West-Hinder", "Ruytingen", "Sandettié" and "Dyck". In January, a few Belgian trawlers went fishing in the eastern Channel off Boulogne.

As to fishing methods, the spent-herring fishery was almost exclusively carried out with the pelagic trawl, towed by two trawlers fishing together.

However, some trips (3.0 %) were made by trawlers using the otter-trawl. As these trips were made casually by sprat trawlers, far away from the grounds, where the herring fishery took place, their catches will not be taken into consideration here, so as not to give an erroneous interpretation of the fishing efficiency of the two methods used.

In Table 33 a survey is given of the fishery effort and yields, comparison being made with the previous season. In this season 89 trawlers were engaged in the fishing (70 in 1952—53) and 594 (561) voyages were made.

Table 33. Fishing Activity—Total Yields and Yields per-Unit-of-Effort (pelagic trawl).

Month	Vessels			Catch (tons)		
	Number	H.P.[1])	Trips	Total	Per trip	Per H.P.
November	24	1.6	12	17	1.4	10.6
December	40	80.8	229	2433	10.6	30.1
January.	66	60.0	198	3752	18.9	62.6
February	40	51.6	154	3968	25.8	76.9
March...	2	0.5	1	4	3.8	7.9
1953—54	89	194.5	594	10174	17.1	52.3
1952—53	70	185.1	561	6130	5.5	33.1

[1]) In thousands of H.P.

2. Landings.

The total catch amounted to 10,185 tons consisting of the following species (pelagic trawl):—

Herring	10,174 tons	99.9 %
Sprat	6 »	0.1 %
Mackerel	+ »	+
Demersal species	5 »	+

In addition 109 tons were taken by means of otter-trawl, mostly herring (99.9 %).

In Table 33 details are given as regards the landings from pelagic trawl. The average yield per trip varied considerably from month to month. It reached maximum in February being 28.8 tons and the average yield for the whole season was 17.1 tons as against 5.5 tons during the previous season.

It is also of interest to consider the effort made and the yield of this effort for a series of part seasons as is done in Table 34. It appears that the number of fishing vessels participating, the number of trips made, the total yield and the yield per-unit-of-effort have decreased. An other important feature is the introduction of the bull-net.

3. The herring stock.

During the season 1093 herrings (12 samples) were investigated, 422 in December, 501 in January and 17 in February.

The size distribution, the average size and the weight of the herring from month to month, can be seen in Table 35. It must be noted that the length (263 mm.) as well as the weight (119 g.) proved to be a little higher than in the previous season (258 mm., 115 g.).

The age composition of the stock is shown in Table 36. The fishing was evidently based on 3—7-year-old herring (year-classes 1946—1950), which contributed altogether by 87.5 % of the total catch. The 3-year-old fish (1950) made out more than a quarter (27.6 %) of the total yield.

The average length of each particular year-class is set out in Table 37, where the difference in length between neighbouring year-classes (annual increment) is also given. Furthermore the growth of the first year (L_1), which terminates when the innermost ring in the scale is formed, is shown.

It is of great interest to compare, over a period of seasons, the average length of the herring in relation to age as it is done in

Table 34. Survey of Fishing Effort and Yields during the Seasons of 1941—42 to 1953—54.

Spent-herring season	Number of trawlers	Number of trip: Indi-vidual trawlers	Number of trip: Bull-net trawlers	Weight landed in kg. Per 1 H.P. × FD: Total	Indi-vidual trawlers	Bull-net trawlers
1941—42	161	2,383	—	10,030,891	119	—
1942—43	290	9,165	—	51,894.746	164	—
1943—44	337	9,379	—	58,119,500	130	—
1944—45	280	3,889	—	31,445,760	160	—
1945—46	345	6,530	—	26,358,947	68	—
1946—47	346	4,639	—	22,171,676	50	—
1947—48	243	2,190	—	6,758,180	32	—
1948—49	258	3,776	—	9,522,110	26	—
1949—50	176	857	436	2,426,337	15	17
1950—51	67	323	18	1,706,233	32	44
1951—52	52	225	177	3,474,793	26	43
1952—53	70	—	561	6,129,695	—	33
1953—54	89	—	594	10,173,492	—	52

Table 35. Spent-Herring - Length and Weight.

Cm.	Length (‰): Dec.	Jan.	Febr.	Average	Average Weight, gr.
30	2	4	—	3	208
29	40	46	41	43	159
28	158	213	77	171	147
27	173	237	159	200	133
26	147	162	141	153	120
25	140	134	241	153	109
24	149	94	223	135	95
23	154	76	112	112	86
22	29	32	6	26	77
21	5	2	—	3	65
20	2	—	—	1	55
Total	999	1000	1000	1000	
Average Length (cm.)	25.9	26.8	25.8	26.3	
Average Weight (gr.)	120	121	110	—	119
% Males	43.5	48.9	42.4	48.1	

Table 36. Age Distribution (‰). N = 804.

Winter-rings	Age, Years	Year-class	Dec.	Jan.	Febr.	Average
1	2	1951	10	3	—	5
2	3	1950	265	221	428	276
3	4	1949	217	204	245	216
4	5	1948	146	126	82	125
5	6	1947	135	121	82	119
6	7	1946	104	161	54	121
7	8	1945	74	89	68	80
8	9	1944	23	32	14	25
9	10	1943	13	20	14	16
>9	>10	<1943	13	23	14	17
Total			1000	1000	1001	1000

Table 37. Average Length, annual Increment and first Year's Growth of the various Year-Classes (in mm.).

Year-class	Aver. length: Dec.	Jan.	Febr.	Aver.	Ann. Incr.	Growth of 1st year (L_1): Dec.	Jan.	Febr.	Aver.
1951	228	231	—	229	—	149	163	—	153
1950	241	240	239	240	11	117	112	119	116
1949	258	261	266	261	21	104	104	108	105
1948	270	271	269	270	9	108	106	100	106
1947	278	278	274	277	7	113	114	110	113
1946	278	281	281	280	3	106	107	93	105
1945	284	281	283	283	3	107	104	104	105
1944	287	284	287	286	3	95	98	124	99
1943	290	285	289	287	1	92	99	103	97

Mean value of L_1 = 109 mm.

Table 38. Survey of Mean Length during the last 7 Seasons (in mm.).

Campaigns	Age (Years): 3	4	5	6	7	8	9	10
1947—48	231	248	256	265	270	273	273	275
1948—49	233	249	255	264	267	273	276	275
1949—50	223	246	254	265	268	272	277	277
1950—51	236	245	257	264	269	274	277	278
1951—52	235	250	260	265	270	276	274	277
1952—53	239	255	268	271	276	279	281	280
1953—54	240	260	270	278	280	283	286	287
General Aver.	234	251	260	267	271	276	278	279

Table 39. Total Number of Vertebrae (VS) ‰.

VS	December	January	February	Average
59	—	8	—	3
58	38	56	59	50
57	**477**	**471**	**473**	**474**
56	465	444	432	450
55	18	21	36	22
54	2	—	—	1
Total	1000	1000	1000	1000
Average	56.530	56.589	56.556	56.562

Table 40. Maturity Stages (‰).

Stages	Dec.	Jan.	Febr.	Average
I	19	6	6	11
II	28	22	—	21
III	—	—	—	—
IV	—	—	—	—
V	2	—	—	1
VI	66	10	—	30
VII	55	8	18	28
VIII-II	830	954	976	909
Total	1000	1000	1000	1000

Table 41. Intestinal Fat.

Quant.	Dec.	Jan.	Febr.	Average
0	182	136	147	155
1	742	832	830	797
+	43	12	23	26
M	33	20	—	22
Total	1000	1000	1000	1000

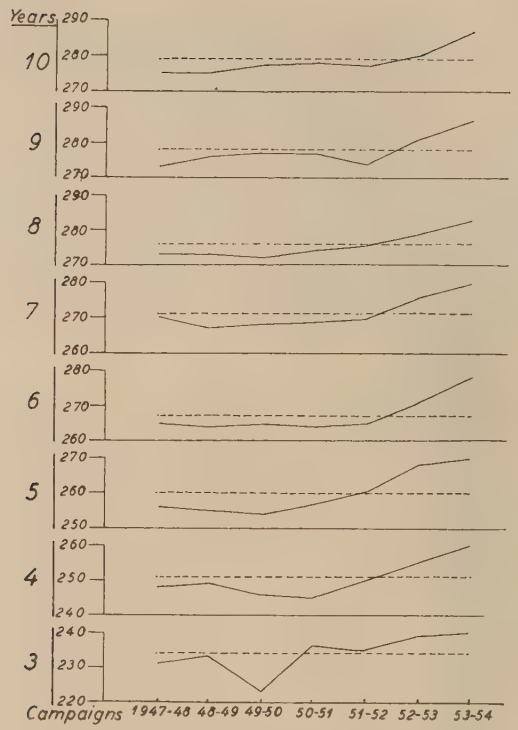


Figure 26. Evolution of the average length of the spent-herring during the campaigns 1947—49 to 1953—54.

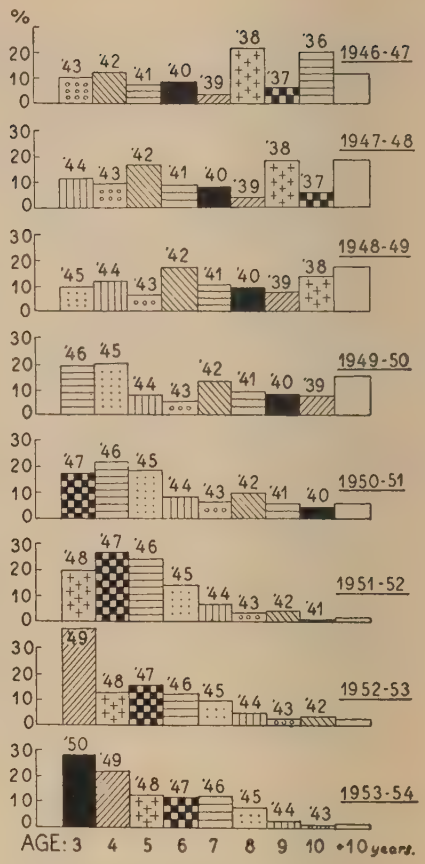


Figure 27. Biological scale of the spent-herring concentrations during the winters of 1946—47 to 53—54.

Table 38. It is quite striking that an increase in length has taken place allover. This phenomenon has already been mentioned by H. Wood (1949) and J. Ancellin (1953). See also Figure 26 above.

The causes of the increase have not yet been fully explained. J. Ancellin (1953) ascribes it to the lesser density of the stock caused by recent year's more intensive fishing, and B. Havinga (1949) apprehends the dangers of an over-exploitation of the stock.

The number of vertebrae was a little lower than last year being 56.56 (against 56.59) as shown in Table 39. Frequency distribution in different months is also shown in this table.

Finally Table 40 and 41 illustrate the number of herrings in the different stages of maturity from month to month (Table 40) and the relative quantity of intestinal fat, also by months. As usual the greatest part of the stock is just spent or recovering spents, and the small amount of fat is in good agreement with that fact.

4. Forecasts for the campaign 1954—55.

The results obtained during the 1953—54 campaign confirm the favourable forecasts given in the report of the 1952—53 campaign.

The forecasts for the probable results of a fishing campaign are mainly based on the frequency of the year-classes observed during the study of the material of the anterior campaigns. So much so, that a good representation of the young year-classes is always considered to be a good omen for the output of the following campaign. As the three-to six-year-old herrings are once again very well represented during 1953—54, we may anticipate good catches during 1954—55.

However, the same restrictions as for the full-herring fishery apply. Indeed, the generalization of the use of the pelagic trawl, the

catching efficiency of which is by far superior to that of the otter-trawl, as well as the ever increasing number of trawlers in activity, may end up in taxing too heavily the herring stock, which are present every winter in the southern area of the North Sea and in the eastern area of the Channel.

It is only in case these apprehensions are not confirmed that satisfactory catches may be excepted to be made during 1954—55.

Ch. Gilis.

Hareng du Sud de la Mer du Nord et de la Manche Orientale, Campagne de 1953—54.

I. Déplacements de la pêcherie boulonnaise. Rendements.

La campagne harenguière d'automne et d'hiver pratiquée par les bateaux de pêche boulonnais au large des côtes de Belgique et du nord de la France a fait immédiatement suite, cette année, à une fructueuse période de pêche du hareng ayant eu lieu au cours de la dernière décade d'Octobre dans une région jusqu'alors peu fréquentée: le banc Indéfatigable, par L.N. 53°35′ et E.Gr. 2°35′ environ.

La campagne a commencé normalement sur les fonds du Sandettié (accores sud-est du banc) à l'époque habituelle: fin Octobre, début de Novembre. Comme d'habitude également elle s'est poursuivie dans ce secteur pendant la majeure partie du mois de Novembre; à la fin de ce même mois les concentrations de harengs se sont portées plus au sud, à l'extrémité ouest de Bancs West Dyck et Out Ruytingen.

Les rendements ont été bons en général, notamment vers la mi-Novembre: 25 à 30 tonnes par jour de pêche pour les grands et moyens chalutiers (bateaux d'une jauge brute de 300 à 500 tonneaux, en moyenne). En dehors de cette période ils ont été — pour le mois de Novembre et pour ce secteur du Sandettié — de l'ordre d'une vingtaine de tonnes par jour de pêche, c'est à dire voisins, ou un peu supérieurs, à ceux enregistrés l'année précédente. Le beau temps continuel a été un élément très favorable à la pêche.

Vers le 10 Décembre les chalutiers commencèrent à exploiter les concentrations de harengs de l'Ailly, en Manche Orientale (par 50°15′ L.N. et 0°45′ E. Gr. environ), exploitation qui fut marquée dans les premiers jours par de bons rendements (40 tonnes par jour de pêche). Elle se poursuivit ensuite jusque vers le 10 Janvier, mais avec des résultats sensiblement moins fructueux (10 tonnes par jour de pêche).

Il est à noter que cette année, plus particulièrement grâce à la détection par les sondeurs à ultra-sons, des concentrations de harengs ont été également exploitées par le travers du Cap Blanc Nez à quelques milles de la côte, pendant la première semaine de Décembre.

En Janvier, enfin, la pêche s'est prolongée plus tard que les trois ou quatre précédentes années: en fait ce sont surtout les chalutiers «boeufs» qui ont continué l'exploitation du hareng guai le long de la côte, de Berck à Calais. Cette méthode de pêche au chalut pélagique remorqué entre deux eaux par deux bateaux — méthode de pêche qui avait fait l'année précédente l'objet de quelques essais dans la région de Gravelines — a été cette année pratiquée par nombre de chalutiers de faible tonnage. Elle a donné d'excellents résultats dans l'ensemble puisque les apports moyens étaient d'environ une vingtaine de tonnes par jour de pêche pour des chalutiers de 50 à 100 tonneaux de jauge brute.

Signalons qu'une douzaine de petits drifters ont encore armé cette année: ce mode de pêche est toujours sur la voie du déclin.

Le beau temps presque continuel a été l'un des éléments les plus favorables à la pêche cette année. La détection par les sondeurs à ultra-sons a permis, en outre, comme les années précédentes, de repérer et de suivre constamment les concentrations de harengs: celle-ci, de l'avis général des pêcheurs et d'après nos propres observations, ont été dans l'ensemble très denses et très stables (contrairement à ce qui s'est passé l'année dernière), mais peu nombreuses et très localisées.

Il est à noter que le marché du hareng a été encombré à plusieurs reprises et a donné lieu à des mesures de restrictions de pêche dont nous avons tenu compte dans l'évaluation des rendements.

En résumé la campagne de pêche, favorisée par le beau temps, a donné lieu dans l'ensemble à des rendements satisfaisants (20 à 25 tonnes par jour), plus réguliers que ceux de l'année dernière. Il y eut quelques pêches particulièrement bonnes dans la région de l'Ailly sans toutefois égaler celles de l'année précédente dans cette même région. Les concentrations de harengs, d'après les indications fournies par les sondeurs à ultra-sons, étaient en général stables, peu nombreuses et très localisées.

II. Conditions hydrologiques.

Nous avons relevé sur les lieux de pêche en Novembre les températures et salinités suivantes (observations faites à bord de chalutiers): —

Date	Position	Profondeur	Salinité	Température
7/11/1953	51°10'L.N. 1°50'E.Gr. (Sandettié)	surface	34.90	14°00
8/11/1953	50°35'L.N. 1°32'E.Gr.	surface	34.50	13°80

III. Composition du stock.

La composition du stock est caractérisée cette année par l'extraordinaire importance de la classe des harengs de 3 ans, c'est à dire des harengs arrivant pour la première fois sur les frayères. Cette classe atteint en effet 47 % du stock, ce qui ne s'est encore jamais produit depuis que des observations sont poursuivies au Laboratoire de Boulogne sur les populations des harengs du sud de la Mer du Nord et de la Manche Orientale. Le plus fort pourcentage constaté jusqu'alors pour cette classe de harengs de 3 ans fut celui de 1937: 34.6 % du stock.

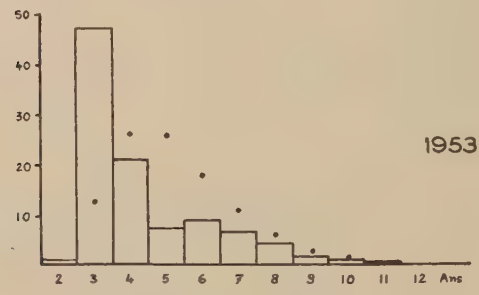


Figure 28. Hareng du sud de la Mer du Nord et de la Manche Orientale: Composition du stock.

Etant donné qu'il s'agit d'un pourcentage la représentation des autres classes ne saurait être évidemment que médiocre ou insignifiante par comparaison: toutes sont largement au dessous de la moyenne, y compris la classe des harengs de 4 ans qui n'atteint que 20 % du stock.

Ainsi pour la septième année consécutive la classe des harengs de 3 ans dépasse sa valeur moyenne d'avant la guerre; pendant les quatre dernières années elle a atteint un pourcentage en général égal au double de cette valeur moyenne, et cette année elle atteint un pourcentage égal au *quadruple*.

IV. Données biométriques.

a) Taille et âge.

La taille par âge a encore légèrement augmenté par rapport à l'année précédente: —

	1952 cm.	1953 cm.
Harengs de 3 ans	24.09	24.16
» » 4 »	25.89	26.03
» » 5 »	27.00	27.03
» » 6 »	27.22	27.81

b) Courbe de répartition des tailles.

La distribution des tailles comporte en particulier un sommet nettement prédominant à 245 mm. (correspondant à la masse des harengs de 3 ans) et un autre moins accentué à 275 mm. La courbe présente donc, comme l'année dernière, deux sommets principaux, avec cette différence que l'abondance des jeunes a fini par donner au premier (245 mm.) plus d'importance qu'au second. Notons que, l'année dernière, le sommet correspondant aux jeunes classes se situait à 240 mm.

Tableau 42.

Sud de la Mer du Nord: Sandettié — Bancs de Flandre — Cap Blanc Nez.
Manche Orientale: Vergoyer — Ailly — Au large du littoral entre Berck et Calais.

A. Taille.

(Ensemble du stock. Taille calculée au millimètre et ramenée au demi-centimètre le plus proche).

cm.	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0
No.	3	10	12	25	49	86	111	126	92
%	0.26	0.87	1.05	2.19	4.29	7.53	9.72	11.04	8.06

cm.	25.5	26.0	26.5	27.0	27.5	28.0	28.5	29.0	29.5	30.0
No.	97	88	76	71	86	79	73	36	14	7
%	8.50	7.71	6.66	6.22	7.53	6.92	6.39	3.15	1.22	0.61

N = 1,141.

B. Age.

Classe	Age	Nombre	%
1951.....	2	11	0.96
1950.....	3	538	47.35
1949.....	4	237	20.86
1948.....	5	86	7.57
1947.....	6	101	8.89
1946.....	7	78	6.86
1945.....	8	49	4.31
1944.....	9	18	1.58
1943.....	10	11	0.96
1942.....	11	6	0.52
1941.....	12	1	0.08

N = 1,136.

En 1949 il se situait vers 220—230 mm. Ce décalage progressif est en corrélation avec ce qui a été observé sur l'augmentation de la taille par âge.

c) Moyenne vertébrale.

La moyenne vertébrale des populations étudiées est la suivante:—

Harengs du sud de la Mer du Nord, 56.55
Harengs de la Manche Orientale, 56.77

V. Remarques et conclusions.

Les observations qui précèdent, notamment celles se rapportant à l'importance persistante de la classe des harengs les plus jeunes, laquelle atteint cette année *presque la moitié du stock*, et l'augmentation de la taille par âge nous conduisent à penser (cf. Ann. Biol. Vols. VIII et IX) qu'une influence marquée de la pêche sur le stock continue à se manifester. Il parait peu vraisemblable, en effet, que les changements dans la composition du stock soient la conséquence d'un apport toujours plus grand de jeunes: à ce compte le stock aurait augmenté dans des proportions considérables; les rendements eux-mêmes devraient augmenter, sinon dans les mêmes proportions, du moins très sensiblement; or ils restent à peu près stationnaires.

D'autre part il est peu probable que les facteurs influençant favorablement la composition du stock et le recrutement des jeunes aient agi dans le même sens favorable pendant sept années consécutives, alors qu'auparavant on constatait des fluctuations d'une année à l'autre.

On doit toutefois noter que les rendements paraissent à peu près stationnaires, sinon en légère augmentation depuis une année ou deux: ceci pourrait nous amener à admettre l'hypothèse d'une sorte d'équilibre entre, d'une part, la diminution du stock et, d'autre part, les conditions favorables *qui résultent de cette même diminution* pour les classes jeunes par suite d'une concurrence vitale moins grande, par suite de meilleures conditions d'accroissement et d'une mortalité moins élevée des alevins[1]).

Ainsi, à l'augmentation factice et illusoire des classes jeunes, due au seul fait que ce sont les vieilles classes qui disparaissent, s'ajouteraient les effets *d'une augmentation réelle* due à une amélioration des conditions de développement des jeunes.

Ceci, de plus, est indépendant des facteurs banaux (température, salinité etc...) appelés à influencer favorablement ou défavorablement le stock et le recrutement des jeunes, facteurs qui devaient être à l'origine des fluctuations observées auparavant d'une année à l'autre. Mais actuellement l'effet de ces facteurs se trouverait plus ou moins masqué par les conséquences d'une pêche présumée intensive.

Il se peut donc que cette année l'extraordinaire abondance de la classe des harengs de trois ans s'explique par une association de causes dont les effets s'ajoutent: —

1) Continuation de la diminution des vieilles classes due à une pêche intensive.
2) Continuation des conséquences favorables imputées à une diminution de la concurrence vitale due à cette même pêche.
3) Existence de facteurs banaux ayant favorablement contribué au développement des jeunes.

Les observations à venir nous montreront éventuellement dans quelle mesure ces explications peuvent être retenues.

J. Ancellin.

[1]) Voir: A. Huntsman: "Fishing and assessing populations". (Cas du Hareng de la Baie de Passamaquoddy). Bull. Bingham Oceanogr. Coll., **11**, art. 4 (1948), pp. 13—17.

Notes on the unusual Presence of large Quantities of Pilchards (*Clupea pilchardus* Walb.) in the Herring Catches from the extreme Southern Area of the North Sea.

I. Large quantities of pilchards were observed in the herring catches from the southern area of the North Sea during the months of November and December 1953.

According to several authors, who described the ichthyological fauna of the North Sea and in particular the fauna of the southern area of this sea, the pilchard makes only occasional and very sporadic appearances in this area. (See Bibliography).

It is not impossible that these pilchards, carried along by the Atlantic currents right through the Channel penetrate ultimately in the southern area of the North Sea. Moreover, the same phenomenon takes place with the herring of the "Channel type" of which very dense concentrations penetrate every winter in the extreme south of the North Sea.

Table 43. Biological and Morphological Features of Pilchard Sample.

Length cm.	No.	‰	Maturity Stages	No.	‰	Mesenteric Fat Quant.	No.	‰	Age Winter-Rings	No.	‰	Vertebrae V.S.	No.	‰	Keeled Scales K_2	No.	‰
21.0	5	139	II	2	56	0	3	83	4	1	31	51	5	179	14	5	139
.5	8	222	III	23	638	1	12	333	5	2	62	52	18	642	15	14	389
22.0	4	111	IV	2	56	+	19	528	6	5	156	53	5	179	16	16	444
.5	4	111	VIII-II	9	250	M	2	56	7	6	188	Total	28	1000	17	1	28
23.0	8	222	Total	36	1000	Total	36	1000	8	8	250				Total	36	1000
.5	3	83							9	3	94						
24.0	1	28							9 +	7	219						
.5	1	28							Total	32	1000						
25.0	2	56															
Total	36	1000															

The **weight** varied between 65 and 115 gr. Average: 88 gr.
Sex. 13 fish or 36 % were males, 23 or 64 % females.
Stomach contents consisted of remains of copepods.

As said above, it was during the months of November and December that large quantities of pilchards were observed in the herring catches and in a smaller measure in those of the sprat.

Unfortunately, we are not able to give official figures of the quantities landed. The pilchards being mixed together with thousands of kilogrammes of herring, their sorting would have meant a tedious and costly work. They were thus sold with the herring and mentioned as such in the statistics.

However, we were able to observe for ourselves that the pilchard was sometimes very abundantly represented in our herring samples. In the herring sample taken on the 14. of December 1953, 36 % of the sample consisted of pilchards. The fact that one factory for tinned fish was able to procure 20 tons of pilchards from the herring catches, confirms this abundance.

Owing to pressure of work due to the herring and sprat studies, it was not possible to analyse a great number of pilchards and 36 specimens only were examined. The results are given in the above Table 43.

Of the 36 stomachs examined, 7 had no contents, 2 were a quarter full, 25 half full and 2 full.

Ch. Gilis.

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II. During the last few years it has become obvious that the number of pilchards taken in the nets of the East Anglian drifters during the autumn fishery has been increasing.

The following table shows the landings at Lowestoft and Yarmouth since 1936 (20 cwts. = 1 ton).

Year	Cwts.
1936	89
1937	4
1938	10
1945—46	8
1947	356
1948	1,495
1949	282
1950	2,722
1951	33,000
1952	1,503
1953	4,800

There is evidence that the fluctuations in the abundance of pilchards in this fishery are associated with the temperature of the Southern Bight in October—December.

W. C. Hodgson.

C. The Skagerak, Kattegat, Belt Sea and Baltic.

YOUNG STAGES

The Density and Distribution of Larvae.

Kattegat and Belt.

By the Danish fishing with the 2 m. ring-net from the S/S "Biologen" only small numbers of larvae of autumn spawning herring were found in the eastern Skagerak, the Kattegat and the northern part of the Belts, but at the same time rather great quantities of larvae of winter spawning herring were found. In the Belts very small quantities of spring spawning herring were found in May but the investigation was carried out before most of the eggs of the spring spawning herring might have been hatched.

In December only small numbers of larvae of autumn spawning herring were found in the eastern Skagerak and the Kattegat, and the same was the case at some few hauls made in the Belts.

COMMERCIAL FISH

Small Herring fished for Industrial Processing.

The Limfjord.

In July 1953 dense shoals of ca. 8 cm. long herring were found at the western entrance to the Limfjord and were fished from some cutters with land seines. Their racial characters were: V.S. 56.44 (181), K_2 15.00 (185), numbers in brackets. It is seen that they were typical autumn spawners from the western North Sea.

Young herring caught in trawls in the Skagerak and the northernmost Kattegat were investigated in 11 catches. Those from January-March were the young of spring spawners of the Atlanto-Scandian type (cp. Table 44).

In 1952 a great part of the 0-group herring caught during summer and autumn were the young of the Atlanto-Scandian type but in 1953 they were North Sea autumn spawners as has normally been the case during recent years. In one of the samples (from 19/11) the low V. S. 56.40 (166) and K_2 14.49 (116) indicate a mixture with coastal spring spawners; the low V. P. (23.97) shows that they were not mixed with the Kobbergrund herring.

One-ringed herring and a few older ones caught in pound-nets in July, and in the trawl in July-November were of the Atlanto-Scandian type.

Central and Southern Kattegat and the Belts.

Samples from the Ålborg bay (north of Djursland) in September-October showed that the 0-group herring were North Sea autumn spawners or possibly Atlanto-Scandian spring spawners mixed with coastal spring spawners.

0-ringed herring from the southern Kattegat from September were Kobbergrund herring (deep-water herring from the northern Kattegat) mixed with North Sea autumn spawners, and some from the Isefjord in October were Kobbergrund herring mixed with coastal spring or winter herring.

0-ringed herring fished in the Great Belt in January-March were pure or almost pure Kobbergrund herring whereas those fished on the 16. February at the northern entrance to the Little Belt were North Sea autumn herring mixed with Belt Sea coastal spring spawners.

Table 44. Samples of 0- and 1-ringed Herrings from the Eastern Skagerak and the Northern Kattegat in 1953.

(In italics: number of herring).

	Date	Gear	No. of samples	Mean length cm.	V.S.	V.P.	K_2
0 ring	7. Jan.	trawl	1	13.0	56.79 *180*	24.09	14.54 *181*
»	5. March	»	1	12.3	— —	—	14.21 *134*
»	14. Sept.—5. Oct.	»	3	9—12	56.51 *1140*	24.06	14.65 *678*
»	5. Oct.[1])	»	1	ca. 14	56.61 *67*	23.93	14.58 *67*
»	7. Oct.—23. Nov.	»	4	11—13	56.43 *420*	23.72	14.66 *284*
1 ring	24. July	pound-net	2	17.6	56.84 *116*	24.24	13.92 *110*
»	Sept.—Nov.	trawl	2	19.6	56.79 *347*	24.16	14.09 *348*

[1]) The largest of the 0-ringed.

Table 45. Samples of 0-ringed Herrings from the Central and Southern Kattegat and the Belt Sea in 1953.

Locality	Month	No. of samples	Mean length cm.	V. S.	V. P.	K_2
Central Kattegat						
Off Mariager fjord — N. of Djursland.	Sept.—Oct.	2	ca. 11	56.45 *377*	23.89	14.23 *138*
Southern Kattegat						
Isefjord	Jan.	1	13.2	55.86 *92*	23.43	14.00 *94*
N. of Seeland	March	1	12.9	56.54 *190*	24.30	14.45 *192*
» »	Sept.	4	ca. 12	56.43 *549*	24.36	14.18 *247*
Isefjord	Oct.	1	14.7	56.24 *191*	24.09	14.48 *138*
Belt Sea						
SW. of Fyn	Jan.—Feb.	2	15	56.08 *145*	23.92	14.15 *149*
Off Kerteminde	Jan.—March	3	13	56.36 *511*	24.14	14.37 *511*
N. entrance, Little Belt	Feb.	1	12.7	56.25 *300*	24.09	14.47 *306*
E. of Langeland	June	1	7	55.89 *162*	—	14.02? *181*
Kalundborg fjord	Sept.	1	12	56.02 *169*	25.28	—
N. entrance, Little Belt	Oct.	1	11.7	55.79 *121*	24.54	14.22 *50*
Århus bay	Sept.—Oct.	5	ca. 12	56.26 *863*	24.74	14.41 *70*
»	Oct.—Dec.	2	12	56.09 *367*	24.86	—
Flensborg fjord	Oct.	1	13.8	55.73 *145*	23.40	13.92 *25*

In June small herring were abundant at several places at the shores of the Great Belt, and from the motorboat "Havkatten" some of them were fished in the southern part of the region (east coast of Langeland, Table 45). Their average length, 7 cm., shows that they were autumn spawners, and their Vert. S. that they belonged to the Belt Sea race of coastal herring. Most regrettably the state of conservation was so bad, when they were investigated, that the V. P. could not be determined, and no doubt the value found for K_2 is too low from the same reason. The discovery for the first time since the 30's, of considerable quantities of local autumn spawners naturally is of very great interest. These local autumn spawners were found unmixed again at the northern entrance to the Little Belt in October (cp. Table 45). In September-December a very great fishing for small herring was carried on in the Århus bay partly also at the north coast of Fyn and these herring were Kobbergrund herring mixed with coastal autumn herring. From the mixture line of these herring in V. S.—V. P. and V. S.—K_2 diagrams it cannot be said if this last-named component is coastal herring of the Kattegat race with V.S. about 56.1 or of the Belt Sea race with V.S. 56.8—56.9 but if they were Belt Sea herring, they constituted about a fifth of the herring in September and the beginning of October and about two fifth in the later samples from the Århus bay. 0-group herring found in the Flensborg fjord in October were Belt Sea spring herring.

Herring caught for Consumption.

Southern Kattegat, Belts and Baltic.

Samples from the spring fishery at the north coast of Seeland and in the Isefjord 28/4 and 5/5 showed that the herring fished here were, as usually, almost exclusively mature herring. Their average length was 22—23 cm. and their racial characters were the normal for the coastal spring spawners (see Table 46).

In February very large herring averaging 25.1 cm. were caught by purse-seine in the Roskilde fjord (in the Isefjord-complex). Their racial characters indicated that they were winter or spring herring with a V.S. a little lower than for the Kattegat spring spawners and a K_2 which is rather intermediate between those for the winter and spring spawners. Most of them were of maturity IV and V.

From Kalundborg fjord (NW. Seeland) a sample also from February and of the same average length was investigated. They were of the same maturities as those from the Roskilde fjord, but while they had the V.S.—V.P. combination characteristic for the spring herring, their K_2 was proportionately high, showing that they were winter spawners.

About the 1. April, samples of herring from Assens (SW. Fyn) and S. of Als showed the racial characters of spring spawning coasta herring. The first were mostly mature whereas those from S. of Als contained about 60 % of 1- and 2-ringed immature herring of average lengths ca. 19 and ca. 22 cm., respectively,

Table 46. Length and Age of Herring caught for Consumption in the Southern Kattegat, the Belt Sea and the Baltic.

In italics at mean lengths: range; at racial characters: number investigated.
N: Gill net; P: Pound net; S: Purse seine; T: Trawl.

Locality	Gear	Month	Maturity	Mean length, cm.		V. S.		V. P.	K_2	
Isefjord — N. of Seeland ...	P	Apr.—May	III-VIII	23	*19—29*	55.96	*301*	23.61	14.03	*295*
Roskilde fjord.....	S	Feb.	IV-V	25	*17—24*	55.66	*168*	23.49	14.01	*164*
» »	S	Dec.	I-V	22	*17—24*	55.77	*177*	23.33	13.99	*174*
Off Kalundborg.....	P	Feb.	III-VIII	25	*20—28*	56.02	*97*	23.67	14.24	*96*
SW. Fyn — S. of Als	P	March—May	I-VIII	24	*19—29*	55.74	*212*	23.39	13.90	*208*
Isefjord.....	P	Oct.	I-II	22	*20—27*	55.43	*140*	23.78	14.11	*140*
Isefjord — N. of Seeland ...	P	»	III-VIII	26	*21—32*	56.05	*167*	24.26	14.34	*167*
S. of Als, Flensborg fjord...	T	»	II-III, VIII	24	*17—28*	55.66	*91*	23.57	14.09	*87*
» » » ...	»	»	IV-V	24	*22—26*	55.93	*33*	23.79	14.44	*32*
At Bornholm.....	N, T	Sept.—Nov.	I—VIII	23	*17—32*	55.37	*352*	23.93	13.59	*341*

while the average length of the mature herring here was only about 24 cm.

While the herring caught in the spring fishery during the last 20 years has normally been spring herring or winter herring, the coastal autumn spawners have been very scarce, and the autumn catches have consisted of a mixture of autumn and spring spawners. This was also found in October 1953 (cp. Table 46) when those of maturities III—VIII caught north of Seeland were Kattegat coastal autumn spawners, while the young immature in the Isefjord were Belt Sea autumn spawners, those from south of Als and Flensborg fjord of maturities II—III and VIII were spring spawners or winter spawners and those of maturities IV and V were Belt Sea autumn spawners.

From Bornholm, samples investigated in September, October, and November showed that only 1/20 of the herring were true autumn spawners. All those of maturities II—III were spring spawners with a comparatively high V. P. which, from investigations in former years, are known to spawn in the Sound and the Baltic.

Aage J. C. Jensen.

Shellfish.

INTRODUCTION

Contributions have been received from:— Denmark, E. URSIN; England, G. DUNCAN WAUGH; France, J. LAFUSTE; Netherlands, P. KORRINGA; and Scotland, H. J. THOMAS.

All the papers, with the exception of the one by M. LAFUSTE, are dealing with *Mollusca*, both oysters and mussels. This gives a good idea of the increasing scientific activity on the fishing and culture of bivalves. In all countries of the I. C. E. S. where bivalve culture is carried on, this industry can expect great profits from scientific work. There is perhaps no branch of harvesting the seas in which greater profits can be drawn from the results of scientific work than in bivalve culture.

In some countries the landings of bivalves have increased considerably. The mussel, *Mytilus edulis*, has specially attracted attention, the more so as the development of the industry is seriously interfered with by the mussel parasite *Mytilicola intestinalis*. There is nowhere any indication that the threat of the parasite is decreasing, but on the other hand it appears that the invasion into non-infected areas goes on very slowly. The paper by KORRINGA, II, demonstrates this very clearly in the Waddensea. From the island of Borkum to the mouth of the Elbe the mussels have been already heavily infected for many years, but the western and north-eastern parts of the Waddensea are completely free from the parasite.

These papers corroborate the opinion that the rapid distribution over so many areas, spread separately over the whole of western Europe is due to transport by men.

As is shown by the paper of KORRINGA the damage done by the parasite in the Dutch Zealand district was so serious that the mussel industry became a complete failure there. The Dutch mussel culture industry, however, has found a way out by moving to the western part of the Waddensea.

The same papers give particulars about the great differences in the numbers of *Mytilicola* in mussels of different habitat in the affected areas.

The papers by KORRINGA, I, and WAUGH firstly mention the fatal influence of the disastrous floods on 31. January—1. February on oysters. Further in both papers a description is given of the production of larvae and the spatfall in correlation to various environmental conditions. WAUGH's paper also contains data on the numbers of microflagellates and the influence of artificial fertilizers on the production of flagellates.

URSIN gives a survey of the stocks of mussels on the natural banks in the Danish Waddensea.

In the paper by LAFUSTE a description is given of the biology of *Crangon vulgaris* in the Baie de l'Aiguillon.

B. HAVINGA.

CRUSTACEA

Crevette grise.

Observations sur la Crevette grise (*Crangon vulgaris* Fabr.) de la Baie de l'Aiguillon.

En 1953 des observations sur la crevette grise ont été entreprises au laboratoire de La Rochelle. L'examen a porté sur des lots provenant de l'entrée de la Baie de l'Aiguillon de Mai à Août, et de l'embouchure de la Sèvre, au fond de la même baie, en Septembre et Octobre.

La dimension des mailles des chaluts utilisés n'a pas permis d'obtenir les individus de longueur inférieure à 25 mm. (du rostre au telson).

Croissance.

Mâles: Pour les individus de plus de 25 mm., la croissance est en moyenne de 1 mm. par mois de Mai à Octobre. A la fin de leur première année les mâles atteignent entre 30 et 45 mm. Par la suite leur croissance est très ralentie ce qui, joint à la mortalité, rend peu abondants les individus dépassant 50 mm. (5 $^0/_{00}$ seulement), la longueur maximum rencontrée étant de 55 mm.

Femelles: La croissance des femelles est également de 1 mm. environ par mois de Mai à Octobre au cours des deux premières années puis elle diminue par la suite. C'est ainsi qu'à la fin d'Octobre elles atteignent:—

	mm.	mode mm.
1ère année:	30—45	42
2ème année:	45—55	51
3ème année:	50—65	57

Au delà de 60 mm. la mortalité devient considérable et 8 $^0/_{00}$ seulement des femelles rencontrées dépassent cette taille, la longueur maximum observée étant de 69 mm.

Répartition des sexes.

	♂	♀
Juillet	26.5 $^0/_0$	73.5 $^0/_0$
Août	36.2 $^0/_0$	63.8 $^0/_0$
Septembre	27.2 $^0/_0$	72.8 $^0/_0$
Octobre	35.4 $^0/_0$	64.6 $^0/_0$

Femelles oeuvées.

La longueur minima des femelles oeuvées est de 37 mm., leur taille modale étant de 52 mm.

Le pourcentage des femelles oeuvées par rapport au nombre total des femelles (A) et par rapport à l'ensemble de la population (B) est le suivant: —

	A	B
Mai	33.0 $^0/_0$	22.2 $^0/_0$
Juillet	30.3 $^0/_0$	22.5 $^0/_0$
Août	42.0 $^0/_0$	26.5 $^0/_0$
Septembre	2.6 $^0/_0$	1.4 $^0/_0$
Octobre	2.1 $^0/_0$	1.9 $^0/_0$

Conditions de milieu.

Les lots récoltés de Mai à Août l'ont été dans des eaux de salinité supérieure à 32 $^0/_{00}$ (près de 34 $^0/_{00}$ en Août). Au contraire, les lots de Septembre et Octobre, bien que conservant la même composition en tailles et sexes, ont été récoltés dans des eaux d'une salinité inférieure à 30 $^0/_{00}$.

J. Lafuste.

MOLLUSCA

Oyster.

Production and Setting of Oyster Larvae in the Rivers Roach and Crouch during 1953.

Stocks of oysters in the rivers Roach and Crouch were satisfactory at the beginning of the year. However, it was expected that mortalities would be above average, because of the prolonged winter and the poor condition of the oysters in the previous autumn. Because of the exceptional conditions resulting from the January floods many oysters were killed either by being smothered under debris from the land, or choked by the silt present in the water (see Waugh 1954).

Rainfall during the summer breeding season was average, totalling 177 mm. during the period 1. June to 14. September, but water temperatures were generally unfavourable. A hot spell towards the end of May resulted in an abrupt rise in water temperature, which increased from 13.6° C. to 18.95 °C. by 26. May. For the rest of the summer, from 23. June to 23. August, temperatures varied considerably, but only remained above 18 °C. for a total of 34 days. At no time was there a long period of hot weather.

Larval production.

Although water temperatures averaged 13—14 °C. at the beginning of June when the first plankton samples were taken, there were small numbers of larvae present. By 22. June

they averaged 370 per 100 litres in the river Roach, although at that time water temperatures had not exceeded 17 °C. for over 3 weeks. The abrupt rise in temperature in May must have resulted in many oysters spawning. These larvae had therefore been liberated in unfavourable conditions. These observations parallel those of 1952 when high temperatures in May resulted in the appearance of larvae at a time when the water was comparatively cold. It will be seen from Figure 1 that in 1953 few larvae appeared to reach the eyed stage. Peak numbers were liberated at the end of June, and there was no second liberation of any magnitude in either river, though small numbers of developing and eyed larvae continued to appear for most of the season. The overall picture obtained from the plankton samples was, that there would be a very poor spatfall.

The numbers of larvae, particularly in the river Roach, showed a marked decline in previous years. Hitherto, there had, in each season since 1947, been a steady increase in the total numbers of larvae liberated. This had been attributed to the steadily increasing stocks of mature oysters built up as a result of conservation of the natural spat, and the relaying programme followed by the Ministry and the Oyster Companies. It seemed that the abrupt decline in numbers of larvae was due to the loss of breeding oysters brought about by the floods. However, the intensity of the spatfall was much greater than was expected from examination of the plankton samples, and this suggests that the "normal" distribution of the larvae had changed with the result that the sampling technique used gave a false picture. One possibility is that the oysters, which had incubated their larvae for longer than usual, liberated them sporadically and not all at the same state of tide, thus giving a much more widespread distribution within the river system.

In the river Crouch, numbers of larvae were also low, though the main liberation occurred at the same time as in the Roach, approximately 9 days after temperatures exceeded 17 °C. The first eyed larvae appeared six days later. The larvae liberated earlier in June failed to grow, presumably, because of low water temperatures. However, this did not apply to the river Roach, where a few of the early larvae grew to settlement size at a time when water temperatures were low, but when there was a steady increase in the flagellate population.

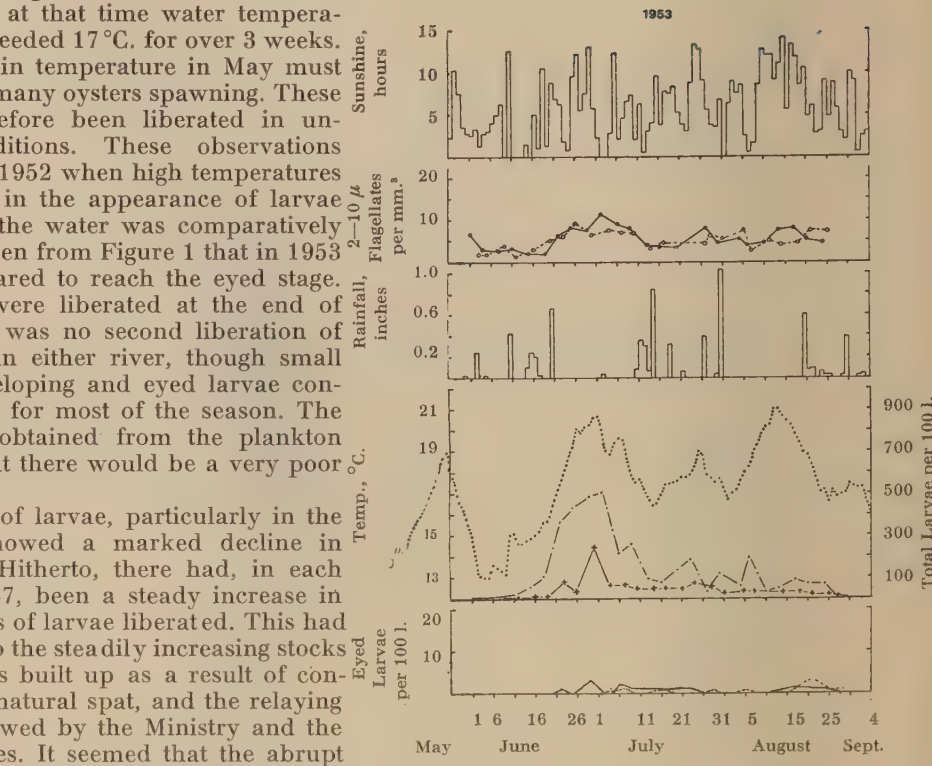

Figure 1. Graphs showing the mean daily water temperature at Paglesham in the river Roach, the total numbers of larvae per 100 litres, the numbers of eyed larvae per hundred litres, and production of 2–10μ flagellates in the rivers Roach and Crouch. Also sunshine and rainfall at Burnham during the 1953 breeding season.

Spatfall.

The small numbers of eyed larvae present in the plankton samples indicated that the spatfall would be meagre, though it had previously been predicted on the basis of observations made in previous years, that it would be of the same order as 1948 or 49. In fact the spatfall was of this density, but its distribution had changed. In previous years the heaviest spatfall had occurred on the up-river grounds,

but in 1953 the most intense spatfall was in the lower Crouch.

Before 1950 there was no reliable standardized technique for estimating spatfall. Reasonably comparable results were, however, obtained by examining a number of clocks (pairs of shells) and estimating the average number of spat per shell in successive years on the Ministry's grounds. 1951 has been omitted; there was virtually no spatfall: —

	Ground	Average numbers of spat per shell				
		1948	1949	1950	1952	1953
River Roach	Broadrakes.....	0.6	0.2	—	—	0.4
	Common Shore	1.4	1.0	—	0.8	—
	Shop Laying ..	4.7	5.2	6.9	1.7	2.8
River Crouch	Fambridge....	1.1	0.1	10.5	0.2	0.4
	Purleigh Shore.	2.2	0.0	5.3	0.05	—
	Creeksea.....	0.5	—	8.7	2.3	4.2
	Southw. Laying	0.8	3.3	1.2	—	9.9

In the lower Crouch on the Southward Laying, the ground nearest the river mouth, settlement was very much heavier than that experienced in the otherwise good season of 1950. In the river Roach settlement appeared to be considerably lower than that experienced in previous years, but comparison of artificial collectors gave a more encouraging picture. The following figures show the average numbers of spat per egg-box collector in the rivers Roach and Crouch for the seasons 1950—51—52 and 53.

Year	River Roach	River Crouch
1950	250	150
1951	0.8	0.2
1952	62	13
1953	120	47

Nanoplankton.

Fluctuations in the microflagellate population were again studied using the method adopted in 1950 (Waugh 1951). The 2—10 μ flagellates reached a reasonably high density at the time of the major larval liberation. Though most eyed larvae appeared in the river Roach at this time they represented a much smaller proportion of the total population than was expected. In the river Crouch the highest numbers of eyed larvae appeared towards the end of August, and at that time there was an increase in the flagellate population. The most striking feature, particularly in the river Roach, was the way the fluctuations in numbers of flagellates followed the changing water temperatures. (Figure 1). Sunshine and rainfall seemed to influence temperature rather than nanoplankton.

It was suggested in 1952 that the flagellate population might be increased by the addition of artificial fertilizers, and in 1953 small-scale preliminary trials were made in the upper reaches of the river Crouch. It was found that, with the quantity used (15 cwt. of superphosphate), the number of flagellates in a localised area was almost doubled, and there was no undue proliferation of diatoms and other forms unsuitable as larval food. The experiment was designed to test the possibilities of increasing flagellate production; it was not intended to promote better growth and survival of larvae. However, having obtained a preliminary success, further trials will be made in 1954 with the object of obtaining locally dense populations of flagellates in those bodies of water which contain the largest numbers of oyster larvae. In this way it is hoped to assess the importance of flagellates in relation to spatfall.

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G. D. Waugh.

Larvae and Spatfall of Oysters in the Oosterschelde (Holland) in the Year 1953.

As it is not only the total production of oyster spat, but also the cost of production of spat per-unit-of-effort which can be favourably affected by a reliable prediction of the setting intensity, we continued our observations on the number and size of oyster larvae in the water of the Oosterschelde in the year 1953. The methods used in collecting samples of 100 litres of water and in counting and measuring the larvae in such samples have been described previously. The samples were again collected at the Yersche Bank station in the centre of the basin of the Oosterschelde. Daily samples were taken at high slack water from 15. June up to 27. June inclusive, but those taken on 18. June and 22. June got lost in transit through breakage of the glass container. Twice-daily samples were taken at high slack and low slack water in the height of the season from 29. June up to 7. August inclusive, except on

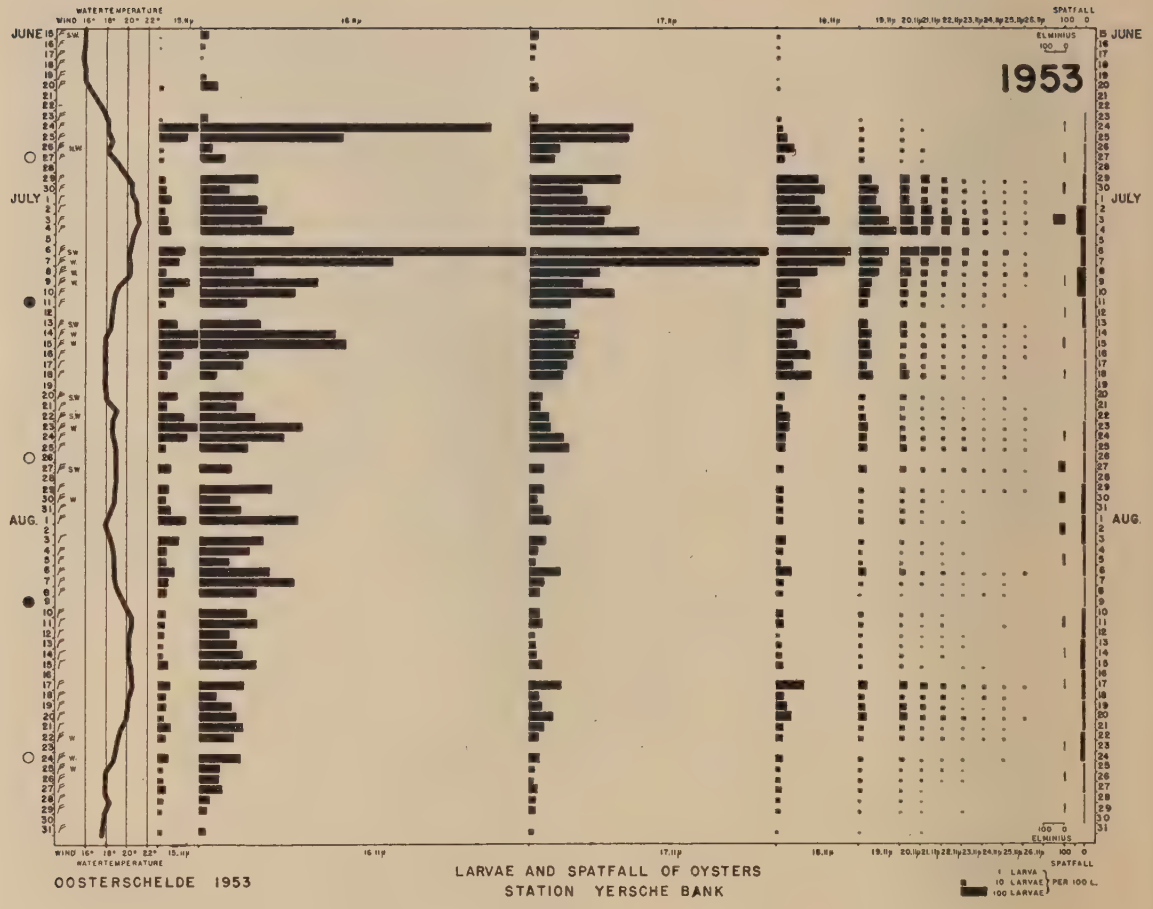

Figure 2.

28. July. From 8. August up to 31. August inclusive daily samples have been collected at high slack water. It was impossible to collect plankton samples on Sundays when our boats stayed in port. When two plankton samples were taken in a day, the average number of larvae in each size-class has been computed for 100 litres, and is depicted in the diagram. (Figure 2). The intensity of setting was measured in the usual way by exposing 3 lime-coated glass slides, measuring 13 × 18 cm., at an angle of 45° in a concrete container for periods of 3 days. The average number of spat per slide is shown in the diagram in Figure 2.

Since the Balanid *Elminius modestus* DARWIN, recently intruded into British and Dutch waters, gives reason for concern, we continued collecting data on its setting on our spatfall slides. To this end we added up the number of *Elminius* found on 5 cm². of the upper surface and the number on 5 cm². of the under surface of each slide, and called this figure the setting of *Elminius* per 10 cm². per period of 3 days.

Our prediction bulletins, now also broadcasted by radio, ran as follows: In the general outlook—based on the size of the oyster stock and on lunar periodicity—an ample production of larvae was predicted, with an important maximum about 7. July. Notwithstanding the great number of larvae we expected—taking into consideration the considerable parent stock—we dared not state that only a cold summer could lead to disappointing results, for many oysters were in a rather poor condition early in 1953, which could have its repercussions on the quality and viability of the larvae

to be produced. This would be far worse than a reduction in the number of larvae produced per oyster. Three factors had contributed to the poor condition of the parent oysters: 1) The water temperature had dropped to a low level enforcing hibernation at an unusually early date. In spring it took a long time before the water temperature rose sufficiently to "awaken" the oysters. 2) Many oysters, though not at all lean, were unusually weak as early as December and January, which should be ascribed to the parasitic flagellate *Hexamita* which often gives reason for concern in the colder season where oysters are numerous (Mackin, Korringa and Hopkins 1952, Korringa, 1951). 3) The disastrous floods of 1. February 1953 led to a high silt content of the Zealand waters, which in its turn gave trouble to the oyster for a prolonged period. Oysters weakened by prolonged low temperatures and by a great number of *Hexamita* in the circulatory system get it when the gills continuously collect considerable quantities of silt. Then mortality may occur, especially in spring. Many oysters died early in 1953—on some plots up to 40 and 50 $^0/_0$—and many of the survivors were rather weak for a long time.

On 22. June very small numbers of larvae were reported to occur in the Oosterschelde; the water temperature being low, spatfall could not yet be anticipated. On 26. June it was reported that great numbers of larvae had made their appearance on 24. and 25. June. This was the first peak in larval production, which is expected about a fortnight earlier than the great annual maximum, now retarded for about 24 hours by the low water temperatures. As we only recorded about 18° C. at the time these larvae made their appearance we could not yet announce a rapid development and important setting. On 29. June we had not yet seen large numbers of umbo larvae so that we could not yet hold out a prospect of a spatfall of commercial importance. On 1. July we reported a rapidly increasing water temperature, a continuing production of young larvae, and such a favourable development of the larvae already present that umbo larvae became numerous. Having observed noteworthy numbers of "mature" larvae ready to settle, a fair setting was announced, which would be continued into the next week. On 3. July this favourable outlook was fully confirmed as the number of umbo and "mature" larvae increased steadily during excellent weather. On 7. July it was stated that very many young larvae had suddenly made their appearance—up to 2000 per 100 litres—this being the annual maximum, whose appearance on 7. July had been predicted long ago. Unfortunately rough weather began to interfere, and on 10. July we reported a rapid decline in the number of umbo and "mature" larvae. This was ascribed to prolonged rough weather and a decreasing water temperature. A decline in spatfall prospects was announced. On 15. July we said that continued unfavourable weather and low water temperatures retarded larval development which had an adverse effect on setting prospects. As there were still quite a few "mature" larvae, which has also been noted on 18. July, we thought that spatfall of some importance could still be expected. Also on 24. July we reported that there still were enough umbo and "mature" larvae to anticipate a light setting, though water temperatures remained rather low. A further decline in the number of larvae of any developmental stage, and thereby of spatfall prospects, was reported on 31. July. Only few umbo and "mature" larvae had been observed in the days preceding 7. August, so that no setting of economical importance could occur at that time. Though as a rule the events after 15. August are only of theoretical interest, we were able to state on 21. August that such a sudden increase in the number of umbo and "mature" larvae had been observed that a fair setting could still be expected despite the advanced season. On 26. August this flare up had come to an end and the season of the oyster's reproduction should be considered as terminated.

It can be seen from the diagram that the measured intensity of setting did not always correspond well with the number of "mature" larvae observed and with our predictions, as in previous years. Fortunately there was no discrepancy in the beginning of the season, for the rapid amelioration in spatfall prospects reported on 1. July and the good setting in the following week, despite rough weather, corresponds well with the great numbers of spat settling on the slides from 2. July to 10. July inclusive. However, the number of spat we found on the slides which had been exposed in the middle of July are much smaller than we could have expected from the reasonable number of "mature" larvae (measuring over 250μ) observed in that period. Further the

apparent increase in setting at the end of July and early in August and again in the middle of August, though neither of great commercial importance, is not reflected by a simultaneous increase in the number of "mature" larvae; and nor do we clearly see the influence of better larval development from 17. up to 22. August in the number of spat counted on our slides. This discrepancy cannot be ascribed to some defect in our spat collector, for 3 containers had been placed in the Yersche Bank station in 1953, one of which held the slides in a horizontal position, and there was a close parallelism in the numbers of spat caught in any of these collectors. Nor can it be the rather poor condition many parent oysters showed in spring, as mentioned above, which can have led to unusual results. The total number of larvae produced corresponds fairly well with our expectations, and was even slightly great in August. At most, we can note that the larvae were of a somewhat smaller size early in the season than is customary. The excellent development of the larvae late in July and early in July indicated that the larvae were as viable and healthy as in previous years. Apparently the difficulties the parent oysters encountered in spring have not been reflected in the quality of the larvae they produced in summer. If there had not been so very many days with rough weather setting would undoubtedly have been better, for there have been reasonable numbers of umbo and "mature" larvae for many weeks. The Yersche Bank station, where the spatfall intensity has been measured, suffers more from exposure than the sites where the majority of the tiles used by the oystermen are placed, these being well sheltered against W. and SW. winds. Further, there has definitely been more silt in the water than in previous years, a result of the floods and of the tidal currents scouring in and out through the gaps in the dikes of the isle of Schouwen-Duiveland. I presume that my slides often received a film of silt, impeding the setting of oyster larvae, and that the discrepancies mentioned above could be ascribed to this phenomenon. The observation in 1953 that upper surfaces caught less than twice the number of spat found on under surfaces of the slides, though 3 to 5 times as much is usual for years with fine weather and low silt content of the water corroborates my view.

The results obtained by the oystermen working with tile collectors were good in the year 1953, many collectors bearing from 50 to 100 young oysters in autumn. This is decidedly better than the data depicted in the diagram for rough weather resulting in high water levels prevailed in the most promising period early in July and made it very difficult to place the tile collectors. Many tiles were placed after 10. July, and still received a good number of oyster spat. Apparently setting has been better in the well-sheltered sites where the tile collectors are placed (Zandkreek, Kattendijke) than in the Yersche Bank station. The practical results indicate that setting on the tile collectors ran more closely parallel to the number of "mature" larvae observed in plankton samples, and to our predictions, than did our measurements of setting intensity in the more exposed Yersche Bank station. Unfortunately many of these tile collectors, well covered with spat, have been crushed in their wintering pits by huge masses of drifting ice in February 1954. This was a severe blow for many of the "tile farmers". Mussel shells scattered on deeper plots collected a fair number of young oysters, though on an average not nearly so much as the results obtained with tile collectors seem to promise. Apparently silt deposition has been an impediment on many a plot.

We have often been asked whether the time-consuming elaboration of plankton samples could not be cut out since we appeared to be able to predict with considerable precision the day when the greatest number of young oyster larvae appear in the water. As this peak is always located between 26. June and 10. July, on an average about 2. July, and as larval development requires 8 to 10 days under favourable conditions, it is not surprising that data collected during many years on the number of spat detached from tile collectors indicate that tiles placed about 10. July show as a rule the best results. It is, however, important for the oystermen to get the maximal output in every season, for the cost of production of spat is in the first place determined by the number of spat setting per tile. The 1953 season demonstrates clearly that a general tendency to catch the spat of larvae produced in great numbers at about 7. July, according to our long term prediction, would have led to rather disappointing results. As soon as we reported that the larvae of the first peak, which appeared 24. June, began to develop well many tiles were placed and with considerable success. In fact the larvae of the first peak

yielded most of the spat setting from 2. July up to 10. July, and the great maximum of 7. July led to a setting of lesser importance, though we have to admit that the commercial set paralleled more closely the number of "mature" larvae than the data on setting depicted in our diagram. Weather conditions, together with other factors influencing larval development, interfere to such an extent that prediction based on daily plankton samples is of much greater practical value than the long term prediction of the day the number of young larvae will reach its highest peak. We therefore consider it commercially sound to continue our plankton sampling.

The setting of *Elminius* was of lesser importance than in 1952. During the entire season we counted less than half the number that settled on our slides in 1952. I do not believe that this difference should be ascribed to deposition of more silt in 1953, for the undersides of the slides caught a smaller and not a higher percentage of the total number of *Elminius* as compared with 1952. The setting of *Elminius* showed marked ups and downs, with a peak about 3. July, and a more diffuse maximum at the end of July. As we did not count its larvae, we cannot say whether the ups and downs parallel larval production and development or should be ascribed to conditions preprevailing during setting.

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P. KORRINGA.

Mytilus edulis in the Danish Waddensea 1952—53.

Since August 1952 the length composition of mussel catches obtained with the modified Petersen young-fish-trawl in the Danish Waddensea has been regularly investigated three times a year (June, August, and October).

In this period there was a large stock of mussels within the area. The mussels were usually fairly small, measuring in most localities about 5 cm. as in Ho Bay (north of Esbjerg) and east of the island of Rømø, both north and south of the dam. These mussels seem to be full-grown because noticeable growth did not occur during the period of investigation. A stock of larger individuals about 6.5 cm. long was found on Langli Sand off Esbjerg. They, too, were obviously almost full-grown in August 1952. Their larger size may be due to better conditions of growth rather than to higher age.

According to BAHR (1949, Fischereiwelt, **1**, 6 p. 86) the stock of mussels in the German Waddensea was considerably reduced during the severe winter of 1946/47. In the summer of 1947 a heavy spatfall took place so that in 1949 the stock was found to consist almost exclusively of the 1947 year-class. E. SMIDT (1951, Medd. Danm. Fiskeri- og Havunders., Fiskeri, **11**, p. 87, and verbal information) has observed similar effects of this icewinter in a locality north of Esbjerg.

There is much in favour of the view that in 1952—53 the majority of the Danish Waddensea mussels were, also, of the 1947 year-class or possibly a little younger.

Young-looking mussels with shiny shells not overgrown with barnacles etc. were observed in numbers in two localities only. In October 1953 the Højer Flak (near the German border line) seemed to be inhabited by young mussels of two age-groups measuring about 3.2 and 0.7 cm. respectively. On estimating the age from the observations af BAHR the larger specimens may be considered to be about one year old, the smaller a few months only. At the same time, a stock of young-looking mussels about 4.5 cm. long were found in the intertidal areas off Havneby, Rømø. Young mussels, however, were nowhere present in such numbers as were the older ones in other parts of the Waddensea.

ERIK URSIN.

Epidemiological Observations on the Mussel Parasite *Mytilicola intestinalis* STEUER, carried out in the Netherlands 1953.

Waddensea.

A superficial study of the statistical data shows that the Dutch mussel industry has made a full recovery. For the first time since 1950, the year in which the parasitic copepod *Mytilicola intestinalis* dealt such a heavy blow to the mussel industry in Zealand, the annual

production of consumption mussels has gained, and even surpassed, its former figure of 50,000,000 kg. Further inquiry reveals, however, that 83% of the mussels sold in 1953 had been produced in the Dutch Waddensea, which leaves only 17% for the Zealand waters, instead of upwards of 95%, considered normal in the years prior to 1950. This demonstrates how much the Waddensea has gained in importance for the Dutch mussel industry. The area west of the Isle of Ameland, which has been allotted for mussel farming, is still completely free of *Mytilicola*. Though danger threatens from the east, as the mussel grounds around the German Isle of Borkum are heavily infested the parasite did not make any headway in a westerly direction during 1953. We again found an occasional *Mytilicola* in the wild mussels behind the Isles of Rottum and Schiermonnikoog, but fortunately we did not detect a real centre of *Mytilicola* west of the Eemswadje, at the easternmost fringe of our territory. Again we observed the highest figures at the entrance of the channels leading to the tidal flats in the transition area. This corroborates my view (Ann. Biol. 1952, 1953) that the few parasites we did find here must have come in from the North Sea, carried by the tidal currents, but these are not numerous enough to build up a new centre of distribution which could entail an invasion of the districts further west.

In view of the great economic importance of the mussel industry in the western part of the Dutch Waddensea, we consider it necessary to keep the transition area under constant supervision.

Zealand.

As had been anticipated (Ann. Biol. 1953) 1953 was a complete failure for the Zealand mussel industry. The young *Mytilicola*, which made their appearance in great numbers as late as October and November in 1952 in so many mussels of any size entered hibernation in juvenile state, and it could not be expected that they would die off early enough in 1953 to cause the noteworthy decline in the *Mytilicola* population which gave the mussels in previous years a chance to recover and to build up a reasonable quality of their edible parts. It was not before July and August that the hibernated parasites began to die off, (again at the age of about 10 months). However, by that time they had already produced such a considerable offspring, that the mussels did not get a chance to recover. The only exception were those planted on a few rather isolated plots where too few larvae entered to make the mussels suffer.

The critical temperature for *Mytilicola*'s reproduction (7 to 8° C.) was attained in the middle of April, but it was not before June and July that great numbers of larvae made their appearance in the intestines of the mussels. Water temperatures being high in that period, it took the larvae only about 7 weeks before they began to reproduce themselves. Already in July it could be seen that the mussels had suffered seriously; they did not grow, showed empty intestines often with symptoms of inflammation, yellow coloured livers, lean watery meats often with a brownish-red tinge, and loss of byssus attachment. Later, mortality began to strike, especially in the Grevelingen district. Few of the mussels grown in Zealand in 1953 attained a quality acceptable for the market. Had it not been for the fact that the mussel farmers had considerable stocks of mussels of good quality on their plots in the Waddensea, 1953 would have been a catastrophical year for them.

Table 1. Water Temperatures in the Eastern Part of the Oosterschelde, °C.

	1950 Basin	1951 Basin	1952 Basin	1953 Basin	1953 W. part
January	3.5	2.5	3.6	1.4	3.2
February	3.8	3.9	2.5	2.7	3.8
March (1st decade)	5.4	4.5	4.7	4.4	5.0
March (2nd do.)	6.9	5.9	5.5	5.1	5.4
March (3rd do.)	7.6	5.7	5.7	6.4	6.8
April (1st do.)	8.1	6.7	6.1	7.5	7.4
April (2nd do.)	8.7	7.5	11.0	8.5	8.7
April (3rd do.)	9.1	9.7	11.7	11.0	11.1
May (1st do.)	10.5	10.6	13.8	12.1	11.6
May (2nd do.)	13.3	11.3	15.4	13.2	12.8
May (3rd do.)	15.0	14.2	15.5	16.4	15.0
June	18.9	17.2	17.0	16.5	15.9
July	20.0	19.0	19.2	19.0	18.7
August	19.5	18.9	19.1	19.1	18.7
September	15.6	17.3	14.7	16.6	16.8
October	11.8	12.1	10.5	13.7	14.2
November	7.1	10.3	6.4	8.5	10.6
December	3.5	5.8	2.1	7.4	9.0

Though many *Mytilicola* continued producing eggs in October and November, favoured by rather high water temperatures, not many larvae made their appearance in the mussel's intestines at that time in the season. We have not enough data at our disposal to decide

Figure 3. Number of *Mytilicola* per mussel and percentage of mussels infested in November 1953. Degree of filling of circles indicates percentage of mussels infested; vertical lines average number of *Mytilicola* per mussel. The diameter of the circles is proportional to the length of the mussels.

whether larval development failed in the autumn of 1953, or whether the greatly reduced activity of the suffering mussels made it difficult for the larvae to find and enter a host. The situation in November 1953 has been charted, in Figure 3. With the exception of some lots of recently planted mussel-seed all are 100% infested by *Mytilicola*, and the number of parasites often exceeds 10 per mussel. This situation very much resembles the catastrophical events in the middle of July 1950 (Ann. Biol., 8, p. 183, Fig. 8). The situation in the Grevelingen district is now even worse than it was in 1950. Were it not that low water temperatures limited the parasite's activity, as late as November 1953, and thereby its ill effects on the mussel, few mussels would have survived. In winter *Mytilicola* hibernates in

Table 2. Some characteristic Events in different Parts of the Zealand Waters.

Date of sampling 1953	Size mussels in mm.	% infested	*Mytilicola per mussel* ♀♀	♂♂	juv.
Plot 432 Geul, Oosterschelde eastern part.					
11. March	44	90	1.1	2.7	0.3
3. April	45	100	2.0	2.8	0.1
7. May	46	100	2.5	3.0	0.4
27. July	48	100	3.8	4.6	9.1
Plot 119 Grevelingen.					
28. July	54	100	2.6	3.8	14.1
17. August	54	100	4.5	3.8	6.1
10. November	55	100	13.0	10.8	2.0
Plot 125 Grevelingen.					
28. July	57	100	2.6	3.0	16.0
17. August	57	100	5.2	5.3	16.0
10. November	57	100	11.3	13.4	0.8

Table 3. The Effect of the Depth of the Plot on the Rate of Infestation with *Mytilicola* and thereby on the Condition of the Mussel.

Grevelingen, Autumn 1953	Shallow part at low water Depth m.	Deeper part at low water Depth m.
Plot 119	1½—2	6—8
Byssus attachment	good	poor
Percentage empty shells	15%	25%
Average shell length	54.6 mm.	52.8 mm.
Internal volume of shells	10.1 cc.	9.3 cc.
Filling intestine (good/fair/poor)	24/44/32%	8/16/76%
Colour liver (brown/yellow)	80/20%	20/80%
Meat (good/fair/poor)	28/48/24%	20/28/52%
Mytilicola per mussel	14.5	21.7
Condition index	94.0	56.0
Plot 165	4—5	11—12
Byssus attachment	good	fair
Percentage empty shells	20%	33%
Average shell length	56.0 mm.	55.2 mm.
Internal volume of shells	11.0 cc.	10.0 cc.
Filling intestine (good/fair/poor)	32/40/28%	12/28/60%
Colour liver (brown/yellow)	80/20%	56/44%
Meat (good/fair/poor	32/56/20%	8/32/60%
Mytilicola per mussel	18.0	24.4
Condition index	95.0	55.7
Plot 101	2—2½	7—8
Byssus attachment	poor	poor
Percentage empty shells	40%	80%
Average shell length	56.7 mm.	57.7 mm.
Internal shell volume	13.0 cc.	12.0 cc.
Filling intestine (good/fair/poor)	24/12/64%	12/20/80%
Colour liver (brown/yellow)	40/60%	44/56%
Meat (good/fair/poor)	32/12/56%	4/32/64%
Mytilicola per mussel	14.4	18.4
Condition index	55.9	40.2

the mussel's intestines. It then does not grow at all, and apparently exerts little influence on its host, which resumes feeding and gets a chance to recover to some extent.

The outcome in 1954 will depend largely on *Mytilicola*'s reproduction in April and May. If this is of the same modest importance as it was in 1951, 1952, and 1953, there is a fair chance that the population will decline in the second half of May and in June through the dying off of the hibernated parasites. This will give the mussels a chance to recover. If, on the other hand, reproduction in spring is comparable to that in 1950, the outlook for 1954 will be very gloomy for the Zealand waters.

In 1953 the critical temperature for *Mytilicola*'s reproduction was reached later than in 1950. Limited reproduction in October and November 1953 cannot be ascribed to low water temperatures, for in October and November 1952 reproduction was of considerable importance. In the western part of the Oosterschelde winter temperatures are higher, summer temperatures lower than in the eastern basin with its extensive tidal flats.

There has not been a great decline in the *Mytilicola* population in early summer for most of the parasites were still too young to die off. Reproduction was of limited importance in spring, but in full swing in the month of July, which led to a catastrophical development on many plots. Only few larvae entered the mussels in autumn.

Contrary to experience prior to 1950, the mussel farmers have now repeatedly observed better growth and quality of their mussels on the shallower parts of their plots. Analysis shows that more parasites entered the mussels in deeper water, which is most probably due to the positive geotaxis of the larvae in later developmental stages. None of the mussels analysed were exposed at low tide. In some years fatal damage can be avoided by concentrating on cultivation in shallower water.

P. Korringa.

The Distribution of *Mytilicola intestinalis* (Steuer) in Scotland.

Introduction.

Following upon the epidemic spread of *Mytilicola intestinalis* in the edible mussel stocks of north-west Europe, a widespread intensive investigation was initiated into the distribution and biology of this copepod and its effect upon the host. *Mytilus edulis* is abundant upon the coast of Scotland, but the stocks are at present almost completely unexploited commercially. In England, on the other hand, there is a thriving mussel industry, and the infections already observed on the beds at Whitstable and in the Medway have resulted in serious mortalities. In consequence, active research has been carried out at Ministry of Agriculture and Fisheries' Experimental Station, Conway, North Wales. The present work, which was carried out by the Marine Laboratory, Aberdeen, is intended as a supplement to the work of the English Department (Cole 1951) in order to complete the records for the distribution of *Mytilicola* in Britain.

Grateful thanks are due to Dr. H. A. Cole for many helpful suggestions, and to District

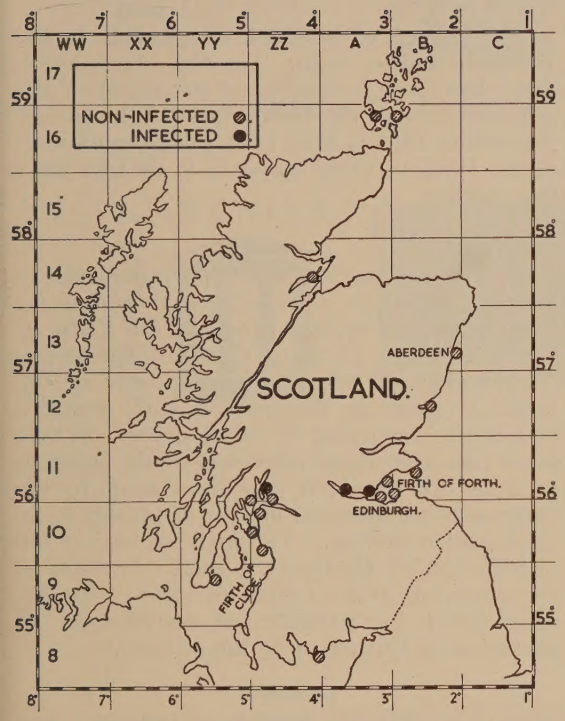

Figure 4. Stations in Scotland at which samples of mussels have been examined for *Mytilicola intestinalis*.

Fishery Officers of the Scottish Home Department for their co-operation in obtaining samples of mussels.

Materials and methods.

Five samples, each of about one hundred adult mussels, were collected from a number of stations at not less than one mile apart in areas which, from the known movements of shipping, appeared most likely focal points of infection. These were obtained during July to September 1951, and were dispatched by rail for examination at the laboratory in the fresh state. The areas sampled are shown in Figure 4. As a result of this preliminary survey, a detailed examination was carried out during November 1951 and again during May 1953, in the infected areas of the Firth of Forth and the Firth of Clyde. In this detailed survey, samples of about twenty-five adult mussels from near low water were examined, immediately on collection at successive stations along the coast, in order to determine the extreme limits of the infected area.

Results.

(a) General Distribution.

Figure 4 shows the stations around the coast of Scotland at which sampling has been carried out. The presence of *Mytilicola intestinalis* was established only in the Firth of Forth and in Firth of Clyde.

(b) The Firth of Forth.

Figure 5 indicates the distribution of *Mytilicola* in the mussel beds of the Firth of Forth, as found during November 1951 and May 1953.

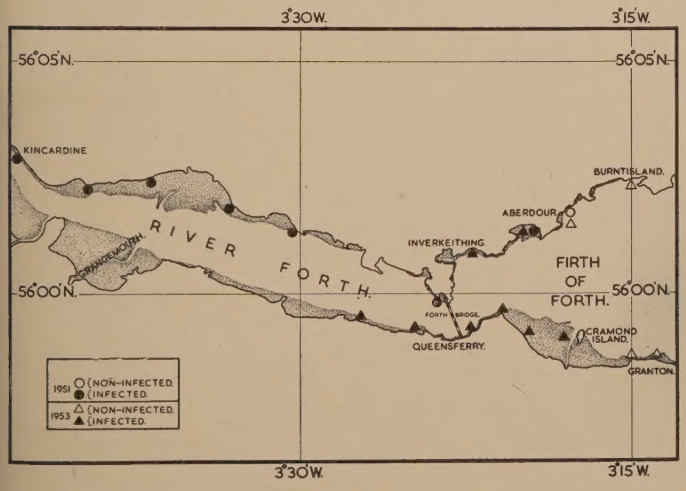

Figure 5. The distribution of *Mytilicola intestinalis* in the upper reaches of the Firth of Forth, 1951 and 1953.

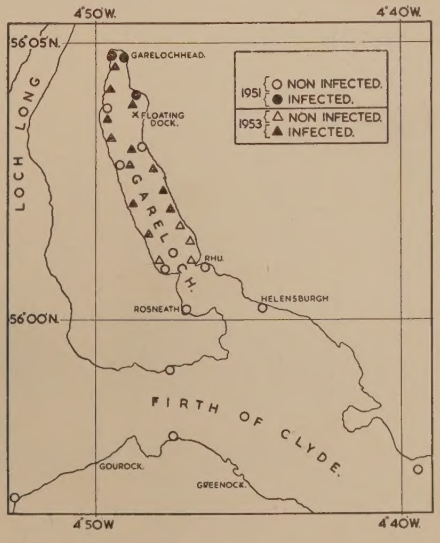

Figure 6. The distribution of *Mytilicola intestinalis* in the Gareloch, Firth of Clyde, 1951 and 1953.

The infection, which is moderately heavy, extends on both banks throughout the upper reaches of the Firth but does not appear to have extended seaward between November 1951 and May 1953. It has not been possible to establish the initial vehicle of this infection, but it would appear likely to have been brought in by some of the ships broken up at Inverkeithing and Rosyth.

(c) The Firth of Clyde.

Figure 6 indicates the distribution of *Mytilicola* on the mussel beds of the Gareloch in the Firth of Clyde, as found during November 1951 and May 1953.

In 1951 the infection was very local at the head of the Gareloch. It is reasonably certain that the origin of the infection was the ex-German floating dock, the history of which is as follows: built 1942 and sited at Lübeck, Germany; left Lübeck about 2. October 1947, arrived Kiel about 6. October 1947; left Kiel 7. October 1947, arrived Brunsbüttel; left Brunsbüttel 10. October 1947, for Barrow, U. K.; towage via North Sea, English Channel and St. Georges Channel; arrived Morecambe Bay 20. October 1947, and ultimately berthed in the Barrow Docks system at Messrs. Vickers Ltd.; left Barrow about 28. April 1950, for Gareloch, arriving on 4. May 1950.

The degree of infection of mussels in the Gareloch is not high. On the other hand, there has been a significant extension of the infected area in the Gareloch over the period November 1951 to May 1953. The remainder of the Firth of Clyde appears to be free from the parasite.

Conclusions.

The occurrence of *Mytilicola intestinalis* in Scottish waters is extremely local and is restricted to two mussel areas in the Firth of Forth and the Firth of Clyde, respectively. The density of infection, particularly in the latter, is small in comparison with densities commonly occurring in other areas. Whilst there has been some extension of the infected area in the Gareloch, the infestation in the Firth of Forth does not appear at present to be markedly extending. The seaward limit of the distribution of *Mytilicola* is relatively close to the probable area of first infection. On the other hand, the parasite has extended to all mussel beds further up to the estuary.

Reference.

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H. J. Thomas.